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INDO-PACIFIC FISHERIES COUNCIL

PROCEEDINGS

1ST MEETING, 24TH—31ST MARCH, 1949

SINGAPORE

INDO-PACIFIC FISHERIES COUNCIL

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SINGAPORE

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OFFICE BEARERS

of the

INDO-PACIFIC FISHERIES COUNCIL, 1949-1950

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Vice-Chairman: - Dr. J. D. F. Hardenberg

Secretary:* - Dr. G. L. Kesteven

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	Mr. Charles Butler

* The office of Secretary is occupied by the officer for the time being provided by F. A. O.

Section 1

REPORT OF PROCEEDINGS

SUMMARY ACCOUNT OF PROCEEDINGS

1. The Meeting opened on Thursday 24th March 1949 at 10.30 a.m. with addresses from the Rt. Honourable Malcolm MacDonald, Commissioner-General for the United Kingdom in South East Asia and from Mr. Norris E. Dodd, Director-General of the United Nations Food Agriculture Organization.

2. The meeting was attended by fifty-two representatives of nine nations. Four of these representatives acted as Observers on behalf of the South Pacific Commission and five other representatives attended as Observers on behalf of Korea, UNESCO and SCAP (see list).

3. The meeting consisted of twelve scheduled and one special session and of various Committee sessions. In addition there were three evening Symposium Sessions.

4. The Council elected Dr. Baini Prashad as its Chairman and Dr. J. D. F. Hardenberg as its Vice-Chairman. These elections were confirmed after adoption of the Council's Rules of Procedure and these gentlemen are therefore the Council's Officers for the current year.

5. The Council discussed Work Paper IPFC/C49/4* and agreed on the general organization which it desired for the Council (see pp. 7-9). On the basis of this agreement on organization and of the Work Paper IPFC/C49/2 the Council discussed its Rules of Procedure and finally adopted them (see pp. 9, 10-11, 14-16 and the finally adopted Rules; also Appendix 5, p. 20-21).

6. The Council decided that there should be two technical committees of the council, one for biology and hydrology and one for technology and economics. These were provisionally appointed during the meeting and formally established in accordance with Section X (2) of the Rules in the final session. The technical committees were given specific terms of reference (see p. 32). Programmes of work were given to the Committees (see pp. 12-13 and pp. 17-18).

7. The Council recommended in connection with the F.A.O. Journey's Fund (Item 11 of the Agenda, IPFC/C49/6) that the Council's expenses should be dealt with through a single consolidated fund (see p. 16).

8. The Council decided to inform the International Commission for Zoological Nomenclature that it had no funds available to enable it to accept the Commission's proposal in connection with standardization of names of commercially important fish. However the Council directed Technical Committee I to communicate with the ICZN to discuss the ways in which such work might be initiated (see IPFC/C49/3 and p. 12).

9. A report was received (IPFC/C49/7) on the matters relating to fisheries discussed at the Seventh Pacific Science Congress (see p. 12).

10. Reports (IPFC/C49/8, and 13) were received from the Technology and Taxonomy Committees appointed at Baguio and were referred to the Technical Committees (see p. 12).

11. The proposal for the establishment of a panel of experts (IPFC/C49/9) was approved in principle and referred to the Technical Committees (see p. 12, also p. 18).

12. The survey of Institutions, vessels, etc was reported (IPFC/C49/12 & 13); the project was approved and Council requested its continuation and completion (see p. 12).

13. The Council adopted a budget for 1949 and submitted comments on commitments for 1950 (see Appendix 3, p. 19, also see p. 14 & p. 16).

14. The Council agreed on a basic publication (the report of its meetings) and on occasional publications in mimeograph form (see p. 14).

15. The Council left it to the Executive Committee to decide on the place of the next regular meeting (see pp. 16-17).

16. The Council devoted a large part of its time to the reading of technical papers of which 18 were contributed (two were not circulated) and 6 were contained in the work paper series. In addition 4 papers were presented during the symposium sessions.

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* Meeting papers are shown as follows: Working papers (see p. 40) as IPFC/C49/ ; Contributed papers (see p. 64) as IPFC/C49/CONTR ; Symposium papers (see p. 118) as IPFC/C49/SYM A series of sessional summary records was issued (see p. 3) as IPFC/C49/SR immediately after the meeting; these are printed in this report on pp. 4-19.

AGENDA AND CONDUCT OF THE MEETING

The Meeting commenced its work with the following agenda:-

1. Address of Welcome by the Right Honourable Malcolm MacDonald.
2. Opening of Meeting by Norris E. Dodd, Director-General of FAO.
3. Reply on behalf of Delegates.
4. Provisional Adoption of Conference Rules.
6. Adoption of Agenda.
5. Election of Chairman and Vice-Chairman.
7. Appointment of Committee of the Conference.
8. Organisation of the Council.
9. Rules of Procedure of the Council.
10. Appointment of Technical Committees of the Council.
11. F.A.O. Journey's Fund.
12. Technical Committees.
13. Adoption of Committee Reports and Recommendations.
14. Publications.
15. Budget.
16. Closure

Within this agenda it was intended to fit the reading of a series of technical papers. It was planned that the matters of the foregoing agenda should be dealt with in the course of twelve half-day sessions. This plan was carried out, although, as was inevitable, it was necessary in doing so to effect considerable changes in the order of the business. The Summary Record of Proceedings show how the business was conducted. Although the provisional programme, in which the agenda items were tentatively assigned to sessions provided 7 out of 12 sessions for the reading of technical papers and discussion of the business of Technical Committees, it became necessary to reduce this allotment to some extent.

In addition to the above agenda, the meeting devoted three evenings to the conduct of a symposium on the question of investigation of pelagic fisheries.

The summary record of the meetings was issued in sections during and shortly after the meeting. For purposes of identification, the following list of those sections is given:-

SR1	Session	1	on March	24
2	"	2	" "	24
3	"	3&4	" "	25
4	"	5 and special session on March		26
5	"	6	on March	28
6	"	7&8	" "	29
7	"	9&10	" "	30
8	"	11&12	" "	31

SUMMARY RECORD OF PROCEEDINGS

24th March 1949

FIRST SESSION. Opened at 10.30 a.m. Dr. J. L. Kask in the Chair.

1. The Right Honourable Malcolm MacDonald, Commissioner-General for the United Kingdom in South East Asia addressed a speech of welcome to the Meeting (see appendix).

2. The Honourable Norris E. Dodd delivered a speech formally opening the meeting (see appendix).

3. Dr. Baini Prashad (India) replied on behalf of the Delegates, thanking the Commissioner-General and the Director-General for their addresses and help, and assuring them of the intention of the Delegations to carry out the Council programme as far as possible.

The meeting then adjourned for five minutes.

4. *Provisional Adoption of Conference Rules (Item 4).* On resumption, the Chairman suggested that there should be a provisional adoption of the rules of procedure in order to provide a guide for the conduct of the meeting.

The U.S. Delegation moved the provisional adoption of the draft rules, circulated by the Secretariat, with the alteration of Rule 7, Section 1, by the insertion of the words "or alternate Delegate" after the word "nominees"; it was stipulated that such provisional adoption should be without prejudice to any discussion to take place in this connection or to any further amendments to these rules which might be proposed. The motion was seconded by the Netherlands Delegation and was carried unanimously.

5. *Appointment of Chairman (Item 5).* The Acting Chairman called for nominations for the office of Chairman. Dr. Clyde (U.K.) in nominating Dr. Prashad (India) said:-

> "The IPFC is a technical body and it is therefore necessary that its office bearer should be a technically qualified person. This is a new organization and it is therefore important that we have as our first Chairman someone of energy and experience. There are other points to be taken into account when we consider the appointment of the first Chairman. Lesser points perhaps, but important in their way; such as availability for meetings and ease of communication. But I think that from the start we should emphasise the principle that the choice should be of an individual and should be made regardless of any accidental circumstance such as where the meeting happens to take place. It does seem to me, Mr. Chairman, and I am sure it will to many others that the Delegate from India, Dr. Prashad, meets all these requirements most admirably. He is a person of considerable standing in the world of science, in biology and in particular in fisheries. He graduated B.Sc. at the Punjab University in 1912, became a Doctor of Science of that University in 1918 and of Edinburgh in 1926. He has been associated with fisheries since he became Principal Fisheries Officer of Bengal, Bihar and Orissa in 1917. From 1920 to 1944 he was associated with the Zoological Survey of India and he was its Director for at least eleven years. He has carried out research particularly in Zoology and in many other sciences. He was appointed Fisheries Adviser to the Central Government of India in 1944.
>
> I have the greatest pleasure Mr. Chairman, in proposing that Dr. Prashad be the first Chairman of the IPFC."

The nomination was then seconded by Dr. Amirthalingam (Ceylon).

Mr. Sette (U.S.) moved that nominations be closed; this was seconded by Dr. Thompson (Australia) and was carried unanimously.

Dr. Prashad was then declared elected Chairman and invited to take the Chair. Dr. Prashad expressed thanks for the honour conferred on him.

6. The Chairman then called for nominations for the position of Vice-Chairman. Mr. Sette (U.S.) said that the U.S. Delegation was in full agreement with the views expressed by Dr. Clyde that considerations of convenience and competence should be borne in mind. He proposed a man who met all requirements and who was known to all at the meeting, Dr. J. D. F. Hardenberg.

Dr. Thompson (Australia) in seconding this nomination, referred to Dr. Hardenberg's considerable reputation for his work in this region.

7. *Adoption of Agenda (Item 6).* On the motion of Dr. Clyde (U.K.), seconded

by Dr. de Jong (Netherlands) the Agenda circulated as IPFC/C49/1, 2nd Revision was adopted.

Dr. Kask read a cable of greetings to the Conference from Mr. D. W. Le Mare, Director of Fisheries, Federation of Malaya and Singapore and a letter from Professor Dr. L. G. M. Baas Becking.

Meeting adjourned at 11.30 a.m.

Appendix 1.

Address by the Rt. Hon. Malcolm MacDonald, Commissioner General for the United Kingdom in South East Asia.

On behalf of the peoples of Malaya I welcome you all to Singapore. We are happy that you have come here for the first meeting of the Indo-Pacific Fisheries Council. This is an important conference. At it men, representative of countries covering about one half the land surface of the earth, are gathered to consider how to exploit the fish swimming beneath about one third of the world's water surface. Here are delegates from Australia, China, Ceylon, France, India, the Netherlands, Korea, the Philippines, the United States of America and the United Kingdom, with Hong Kong, the Federation of Malaya, Singapore and British Borneo. With you are representatives from the United Nations specialised agencies—the F.A.O. and U.N.E.S.C.O.—as well as of the International Union of Biological Sciences; and some of you are observers for the South Pacific Commission.

If I were a fish, I should regard this assembly of piscatorial pundits with a truly cold and fishy eye, suspiciously and apprehensively. Indeed, I should probably try to discredit your efforts by crying "Stinking Fish". But being an ordinary consumer of fish, who knows what a bounteous, health-giving contribution fish can make to the diet of the human race, I, like countless others, look upon your conference with high appreciation and hope.

I am not going to say anything to you about the science of fishing. Far be it from me to try to teach my grandmother to eat caviar. I shall only remark on two points.

First, your Council is, thank heavens, not a political body. You can avoid politics like the plague. The Indo-Pacific Fisheries Council is a technical and scientific body. Its Constitution and draft Rules provide that when your problems spill over into the muddy pools of political policy, you can leave them there to be disputed by other organisations. So, as trained technicians and scientists you can deal faithfully and freely with facts, and exchange information about the facts with a single-minded devotion to the truth, and formulate on the strict merits of the facts those integrated programmes of international work which are most desirable. You can confer here in that objective spirit which is congenial to men of your high professional integrity and wisdom. Incidentally, Mankind will gain most from international work conducted in that spirit.

The other thing that I should like to say is this. I am glad that you are including in your discussions what are called Socio-Economic questions. Large populations of some of the finest types of inhabitants of Malaya and other countries in this region are fishermen. They and their families depend for their livelihood on fishing. They are skillful and courageous seamen, but often their methods are traditional and simple—even primitive. They can be greatly aided by modern technical knowledge. Their boats and fishing nets and other gear can be improved. Their handling of their business can be brought more up to date. Then their labour will be more profitable, their livelihood more secure, and their lives more prosperous.

You members of this conference can help to bring modern science, with all its gifts, to these splendid peoples. That is one of the reasons why we extend a hearty welcome to you in Singapore.

It is fortunate that Mr. Norris Dodd, the charming, distinguished and able Director-General of the F.A.O., is here today. We are delighted to greet him for his own sake, and also because of the noble work which his world-wide Organisation is doing for humanity. It is a happy circumstance that he arrived here at the time of the first meeting of this Council, and I have pleasure in inviting him to open the Conference.

Appendix 2.

Address by the Hon. Norris E. Dodd, Director General of the Food and Agriculture Organisation of the United Nations.

Your Excellency, Ladies and Gentlemen—I am extremely happy to be here today for this inaugural meeting of the Indo-Pacific Fisheries Council. The Food and Agriculture Organisation of the United Nations is greatly indebted to Your Excellency and to your Government for the generous and excellent arrangements which have been made for this meeting. I am sure that these will contribute greatly to the success of the deliberations which are to take place here.

It has long been an ambition of mine to visit Singapore, for naturally enough it is a name which rings familiarly in my ears. I do not need to tell you of the economic significance of Malaya and Singapore with their trade, their rubber, copra, tin and other commodities and you will well understand that in my work I find the items of great interest. To be able to see something of these industries for myself, and to discuss the problems with those immediately concerned with them, is of obvious advantage to me in the discharge of the responsibilities of my position.

But above this, Singapore commands attention by its historical connections. On that very account it is fitting that this meeting should take place here. I venture to suggest that this will prove an historic occasion and it is well that it should take place in these surroundings. Moreover we may note that one of the decisive steps which led to the formation of the Indo-Pacific Fisheries Council at this time was a fisheries meeting held here in Singapore in January 1947. A recommendation was made at that meeting that a Council should be formed, well, here it is.

I said just now that I regarded this as likely to prove an historic occasion. I do so because of the importance which I attach to this meeting. As Your Excellency has said, this is a technical meeting to discuss technical questions; they are questions relating to that most crucial question with which the whole world is faced, namely, from whence are our supplies of food to come.

You will be undertaking your deliberations in the light of a world food situation which is, to say the least of it, alarming. This is particularly true here in the Indo-Pacific area in view of the fact that more than a billion people, comprising more than half of the population of the world, live in this area and depend almost exclusively on rice for their livelihood. They have only one-fifth of the world's land surface on which to raise the food that they so badly need. Much of the land on which they work yields comparatively less food owing to soil erosion, soil exhaustion and lack of fertilisers. F.A.O., in co-operation with the newly formed International Rice Commission, is making every effort to solve some of these problems and to increase production, improve distribution, conservation and consumption methods, but the fact remains that at the present time rice production is still 2.9 million tons short of the pre-war average and, after four postwar years, many thousands of people in these deficit areas continue to receive even less than the meagre portions they ate in the years before the war. It is apparent that, even with the most strenuous efforts, it will not be possible to increase rice production to m et demand. If you gentlemen can devise means by which the riches of the seas and the inland waters of this area can be made to supplement to a great degree this meagre and inadequate rice diet, you will have contributed greatly to stablising the standard of living of these unfortunate peoples.

The war against starvation and want is a total war. It cannot be fought on isolated and unrelated fronts. It must be fought in terms of the battle to increase production, to improve distribution to provide better means of conservation, and to raise nutritional standards. One of the most important fronts in this war is the battle to increase the yield from the sea and inland waters. Our world food problem is brought more forcibly to our attention when we realise that in the past ten years the population of the world has increased by 200 millions, the greater part of that increase coming in the Indo-Pacific area. We have been fortunate in recent years in having good harvests in many lands, but we cannot expect these good harvests to continue from year to year. A serious crop failure in any of the major food producing areas could have dangerous repercussions. We cannot expect people who are hungry and who see their families in peril of starvation to lead normal, peaceful, happy and productive lives. This rapidly increasing population is forcing us to seek for food in new fields. That, Gentlemen, will be your task.

Looking further, I am impressed by the international character of the problems which this Council will discuss and the need there is to ap-

proach them from a view point which, shall we say, is a-national.

Firstly, several nations own the shores of each of the many seas of this area, and the high seas belong to everyone. Secondly, whatever national boundaries there are in the laws of men, in the laws of nature there are none. Thirdly, the problems of the organisms and the elements of the waters themselves defy any human attempt to set boundaries; Malaya and Siam for instance must confront and solve problems which are often the same or very similar. All this means that these countries will inevitably use similar equipment and similar methods for solving their problems. To make their results comparable they must standardise their equipment and methods. This is the first way in which they can help one another—by exchanging views and information on the attack upon problems and the tools to be used. Then when these programmes begin to furnish results, these too should be speedily exchanged, and made available to one another; for in some cases the results will suggest lines of thought and experiment which may in turn yield profitable results.

I shall not attempt to point out to you who are experts in this field the various steps which could or should be taken. That is for you gentlemen to determine.

The immediate aim of the Indo-Pacific Fisheries Council is "the development and proper utilisation of the living aquatic resources of the Indo-Pacific areas through the encouragement and co-ordination of research and the application of improved methods." This, of course, is a very broad term and I should like to add a note of caution. It seems to me that in your deliberations it would be well to concentrate on those subjects which can show quick results rather than on spending your time on research for research's sake. I am fully cognisant of the importance of research, but I feel that at this critical time it is most important that we all bend our energies to bring about an immediate alleviation of the present serious situation. I do not mean that we can expect miracles to happen overnight. We cannot. Nor can we solve all the manifold problems which are before us in even the next five or ten years. But I do suggest that you devote your attention to things which can be done and done now. For instance, we all realise that it would be highly desirable to have modern mechanised fishing fleets operating throughout this whole area but we also realise that it will be some time before this can happen. We cannot discard the fishing junk prematurely. We can, however, take steps to improve the sails, the fishing gear, the nets, etc.

F.A.O. will, of course extend all possible aid to the Council. We cannot build canneries but we can supply experts in canning. We cannot provide modern equipment but we can provide experts who will teach others how to use it. We cannot supply varieties of oysters for breeding purpose but we can use our good offices to persuade governments to exchange varieties and species and to exchange information concerning them. Of all the many fronts in this total war against starvation and want, the battle to wrest the secrets and resources from the sea appears to be the one which gives best promise of an early victory. It is my sincere hope that your discussions here and in the days to come will help to bring that victory about. I wish you all well in this tremendous task and pledge the full co-operation of the Food and Agriculture Organisation. I therefore have the honor to hereby declare the Inaugural session of the Indo-Pacific Fisheries Council open.

SECOND SESSION. Commenced at 2.30 p.m. Dr. Baini Prashad in the Chair.

1. *Appointment of Committees of the Conference (Item 7).* It was agreed to appoint a single Committee of the Conference, consisting of the Chairman, Vice-Chairman and Secretary, and all the Delegates and that this Committee should be responsible for matters of steering and drafting and, in particular, for drafting the Council's Rules of Procedure.

The meeting was then resolved into a Committee of the whole for discussion of Items 8 and 9.

2. *Organization of the Council (Item 8).* The Chairman invited discussion of Working Paper IPFC/C49/4.

Dr. Thompson (Australia): said that his Government considered (a) that the unnecessary proliferation of committees should be avoided; (b) that as much work of the Council should be done by the Secretariat as possible; (c) meetings should be convened at times related to the U.N. schedule of meetings; (d) meetings should not be at fixed 12-monthly intervals. In general his Government

desired that flexibility and economy should be observed and the convenience of officers should be considered.

Dr. Amirthalingam (Ceylon): indicated himself as being in favour of few committees and flexibility.

The question of special meetings was discussed. Dr. Thompson (Australia) indicating a wish that such meetings should be kept at a minimum. Mr. Sette (U.S.) concurred in this view. Dr. de Jong (Netherlands) considered that the possibility of special meetings should be retained.

The Chairman then asked whether the principle of an Executive Committee, as described in the Working Paper, was acceptable. Approval was indicated.

The proposal for technical committees was discussed and much attention was paid to the propriety of including socio-economics within the Council's scope of interest. Dr. Flory (U.S.) asked for a more concise and clear definition of functions proposed for the socio-economics committee; he questioned the appropriateness of the formation of such a committee. Dr. Thompson (Australia) and Dr. Amirthalingam (Ceylon) favoured the four committees proposed. After further discussion it was agreed that there should be two technical committees.

The section of Working Paper IPFC/C49/4 dealing with meetings was then discussed and approved.

It was then decided that the Rules of Procedure should be considered by the Steering and Drafting Committee in accordance with the afternoon's discussions.

Meetings adjourned at 4.30 p.m.

In the evening, at 6.30 p.m. the members attended a Reception given by the Honourable Norris E. Dodd, Director-General of the Food and Agriculture Organization of the United Nations.

25th March 1949.

THIRD SESSION. Commenced at 10.20 a.m. Dr. Baini Prashad in the Chair.

1. *Appointment of Technical Committees (Item 10).* The Chairman reported that at a meeting of the Steering Committee it had been decided to recommend the appointment of a chairman and a rapporteur for each of the two technical committees. The names of Dr. Panikkar as Chairman of the first committee with Mr. Schuster as its Rapporteur and of Dr. Amirthalingam as Chairman of the second committee with Mr. Martin as its Rapporteur, were proposed. Dr. Clyde (U.K.) moved, and Dr. de Jong (Netherlands) seconded, that the appointment of these officers be approved. Adopted.

2. *F.A.O. Journey's Fund (Item 11).* The Secretary presented the Working Paper IPFC/C49/6 and gave further explanation of the nature and history of the arrangement. Dr. Thompson (Australia) presented the view that the expenses of the Council's Secretariat should be fully provided for by the F.A.O. This view was supported by Dr. Amirthalingam (Ceylon), Dr. de Jong (Netherlands) and Mr. Martin (Philippines). Mr. Sette (U.S.) asked what would be the effect on the Secretariat's work of the termination of this arrangement. An explanation of F.A.O's budgetary position was made by Dr. Kask. Dr. Clyde (U.K.) stated that whilst he supported the Australian view of a consolidated fund he felt that perhaps it would be desirable to continue the arrangement temporarily. He asked what was meant by the F.A.O. undertaking to provide the Secretariat. Dr. Panikkar (India) felt that work should be carried on and perhaps the fund continued but a distinction should be made between visits made at specific invitations of Governments and those made as F.A.O. work. Dr. Wu (China) felt that Governments should contribute. Mon. Lemasson (France) agreed in principle with the fund and felt that if necessary the sum of £150 should be increased. Dr. Flory (U.S.) asked for further information on the origin of the arrangement.

It was agreed to defer further discussion, and decision, until the Budget could be considered. Delegations were then invited to nominate additions to the Steering Committee.

Meeting adjourned at 11.25 a.m.

3. Meeting resumed at 12.15 p.m., and resolved into a Committee of the whole to discuss the Rules of Procedure (Agenda Item 9).

Languages: There was a discussion of the official language, or languages, of the Council, Mon. Lemasson (France) submitting that French should be made the official language with English and that this should be embodied in the Rules as a principle. Questions of time and cost were discussed and finally it was suggested that an arrangement might be reached whereby all papers in French would be translated into English and circulated as normal working papers and that it should be left to the discretion of the Secretariat to decide which papers in English should be translated into French.

Rule I. Dr. Flory (U.S.) requested a definition of "Secretariat" but after discussion it was decided to pass over the possible need for such a definition until later when the need for other such definitions might be found.

Rule II, Para. 1. It was agreed to change the words "in the month of . . . . . unless" to "in the first quarter of the year unless".

Meeting adjourned at 12.50 p.m.

FOURTH SESSION. Commenced at 2.30 p.m. Dr. Baini Prashad in the Chair.

Rules of Procedure (Item 9). Resumed in discussion as a Committee of the whole.

Rule II, Para. 2. There was discussion of the purpose of convening special meetings. It was agreed to change the words "at least one-third of" to "the majority of" in the second line.

Para. 3. It was agreed to change "forty" to "sixty" in the second line and "twenty" to "thirty" in the sixth line.

Para. 4. Adopted.

Rule III, Para. 1. Agreed to delete the words "others participating" and to insert after "bodies" the words "invited to attend such sessions".

Para. 2. Adopted.

Rule IV, Para. 1. After di cussion of whether a time limit for submission of items for the agenda should be set it was decided not to introduce such a change and the paragraph was adopted.

Para. 2. Adopted with substitution of "agreement" for "constitution" and deletion of the words "if any" from Part c.

Para. 3. Adopted with the change of "forty" to "Sixty".

Para. 4. Adopted with insertion of "provisional" before the word "agenda" at end of second and last lines.

Dr. de Jong (Netherlands) reiterated the hope that invitations to Governments or Organizations not members of the Council would be the exception rather than the rule.

Rule V. Secretariat.

After some discussion, during which Dr. Kesteven's activities, both in the role of Regional Officer of F.A.O. (Fisheries) and that of Secretary of the I.P.F.C., were outlined, it was agreed that V(1) and V(2) should be amalgamated to read:-

> "The secretary shall provide such secretarial services to the Council and its Committees as the Executive Committee or the Council may from time to time direct and as the facilities of his office permit; and in addition it shall be the duty of the Secretary to receive, collate and circulate documents, reports and resolutions of the meetings of the Council and its Committees; to prepare the records of their proceedings, and to certify expenditures and financial commitments."

Para. 3. After some discussion it was agreed that V(3) should read "Copies of correspondence concerning the affairs of the Council shall, where appropriate, be sent to the Secretary for information and record". This paragraph V(3) is now numbered V(2).

At 4.30 the chairman closed the meeting in order that the Technical Committee might go into session and arrangements might be made for the next day.

In the evening members attended the first session of the symposium and heard and discussed the paper "A Survey of the Pelagic Fisheries of the World" by H. S. Rao and N. K. Panikkar, which was read by Dr. Panikkar (IPFC/C49/SYM. 1).

26th March, 1949.

FIFTH SESSION. Commenced at 10.00 a.m. Dr. Baini Prashad in the Chair.

1. Cdr. Krauss read his paper (IPFC/C49/CONTR. 6) entitled "Oceanography in the Indonesian Archipelago". The paper was followed by some discussion.

2. Mr. Warfel read the paper "Notes on the Oceanography of the Sulu Sea" by H. W. Grahame. This was illustrated by lantern slides.

In the discussion which followed Dr. Kask requested information on stations outside the Sulu Sea; Dr. Hardenberg asked for information on distribution of fish; Dr. Thompson expressed appreciation of the paper: he said he was interested in the stability of the system described, he regarded such conditions as having considerable bearing on the distribution of fish.

Meeting adjourned at 12.15.

SPECIAL SESSION. Commenced at 2.00 p.m. Dr. Baini Prashad in the Chair.

Rules of Procedure (Item 9). Resumed in discussion as a Committee of the Whole.

Rule VI. Adopted after inclusion of the words "members of F.A.O. but not members of the Council" after the word Governments in the third line.

Rule VII. Mr. Sette (U.S.) proposed that the last sentence of the second paragraph be replaced by the words "after 1952 they shall not be eligable for re-election". The proposal was withdrawn after discussion. Paragraph 1 was adopted with the the inclusion of the words "alternate delegate" after the word "Council" in the 4th line. Paragraph 2 was altered to provide for office to extend from beginning to beginning instead of from end to end of the meetings, and thus read: "The Chairman and Vice-Chairman shall hold office from the beginning of the regular session in which they are elected, until the time of election of the Chairman and Vice-chairman at the beginning of the next regular session. They shall be eligible for re-election."

Rule VII, Para. 1. Adopted with the addition of the following to the first line "In addition to exercising the powers conferred on him elsewhere in these Rules the Chairman shall ... ... ".

Para. 2. Adopted.

Para. 3. Adopted with change of "an" to "the" in the second line and deletion of "on the Council" from the third line.

Para. 4. Adopted.

Rule IX. Adopted without alteration although there was some discussion of the last sentence of para. 7.

Rule X, Para. 1. Dr. Flory (U.S.) proposed deletion of the words "and the Secretary" from the second line. After discussion, during which F.A.O.'s position was described by Dr. Kask and the problem of providing an adequate executive committee was examined, the U.S. proposal was withdrawn and the paragraph adopted unaltered.

Para. 2. Mr. Sette (U.S.) proposed the deletion of the original paragraph and its replacement by the following, which was agreed to:

"2. There shall be two Technical Committees, (1) Hydrology and Biology, and (2) Technology, and each member of the Council shall be entitled to membership thereof. The terms of reference of these Technical Committees shall be determined by the Council.

(a) At each regular meeting the Chairman shall poll the delegations to determine if they desire membership on the Technical Committees. Each member of the Council, through its delegate, shall indicate the person or persons it desires to serve on such Committees.

(b) The Technical Committees shall select a Chairman and a Secretary from among their members, who shall serve until the next regular session of the Council.

(c) The Technical Committees shall report to the Council through the Executive Committee at each regular or special session.

(d) The Technical Committees may establish from time to time, such interim sub-Committees as may be necessary effectively to comply with the terms of reference of the Committees, or to perform any special functions in pursuance thereof."

Paras. 3 and 4. Agreed to delete.

Rule XI, paras. 1, 3, 4, and 5. Adopted. Agreed to delete Para. 2.

Para. 6. It was agreed to adopt this in the following form: "Where two or more members of the Council decide to undertake and finance co-operative or joint projects in accordance with Article VI, paragraph 4, of the Agreement, they may, if they wish, transmit through the Counil a request to the Organization that it undertake the financial administrative services necessary to such an undertaking."

Rule XII. Mr. Sette (U.S.) proposed the inclusion of a new paragraph, as follows, with alteration in the numbering of present paragraph. This was agreed.

"1. Invitations to the sessions of the Council shall be sent to those public international organizations having relationship with the Organization which provide for reciprocal representations and to those international non-governmental organizations entitled by their agreements with Organi ation to participate as observers."

Para. 2. For the words "and of participating" put the words "but not members of F.A.O. and of invited"; adopted with this alteration.

Rule XIII, Para. 1. Adopted.

Para. 2. Adopted with deletion of the words "delegate of" from the fourth line.

Para 3. Adopted with deletion of the words "in such manner" from the fourth line.

Rule XIV, Para. 1. Adopted with deletion of the second sentence.

Para 2. Adopted in the following form:-

"The Secretary shall receive on behalf of the Committee the replies of the Members in respect of such recommendations by the Council and shall prepare a summary and an analysis of such communications for presentation at a session."

Rule XV. Adopted after deletion of the words "of the Council" from the 2nd, 4th, 7th and 11th lines.

Rule XVI. Adopted.

The meeting adjourned at 5 p.m.

28th March, 1949.

SIXTH SESSION. Commenced at 10.20 a.m. Dr. Baini Prashad in the Chair.

1. The Chairman, on behalf of the meeting, expressed a hearty welcome to the Korean delegates and said that any contributions made by them would be very welcome. He also said how very glad the assembly was that Mr. Herrington had found it possible to attend.

2. Dr. Panikkar (Chairman of Technical Committee No. 1) read out the programme compiled by the Committee at their meeting of that morning. Various suggestions re-wording, etc. were put forward and amendments made.

3. Mr. Lin (Hong Kong) then spoke on "Notes on Fsh Fry Industry of China" (IPFC/C49/CONTR.1) and "Fish Culture in Ponds in the New Territories of Hong Kong" (IPFC/C49/CONTR.10) and illustrated his talk with lantern slides. A long discussion then ensued and various questions on the subject were addressed to Mr. Lin.

4. Abstracts of papers "Bangos Cultivation and its Relation with algae culture in the Philippines" (IPFC/C49/CONTR.4) and "The Culture of Lab-Lab, the natural food of the milkfish fry and fingerlings under Cultivation" (IPFC/C49/CONTR.5) were read by Mr. Martin (Manila) and various points brought up and discussed.

5. Mr. Schuster (Netherlands) read his paper "On the Food of the Bandeng (Chanos chanos Forsk.) in Indonesian Ponds". (IPFC/C49/CONTR.7). Various questions were then put to Mr. Schuster concerning the paper and general discussion followed.

Mr. Warfel said he thought this paper was a very fine piece of work and served as a good basis for future work. The Chairman concurred in this and said he hoped that similar work would be undertaken. He said he hoped that in this committee definite arrangements could be made as to the lines of work to be adopted.

The Chairman then said that the two Technical Committees would meet at 9 o'clock on the following morning. He said that he hoped that the various delegations would elect members to serve on these

committees before the Council met again in full session.

The Meeting adjourned at 12.15 p.m.

In the afternoon members attended an excursion to Kelongs near Singapore.

In the evening at 6.30 p.m. members attended a Reception given by Mr. J. A. Thivy, representative of the Government of India, Singapore and at 9.00 p.m. attended the second symposium session to hear and discuss a paper by Mr. O. E. Sette entitled "Methods of Biological Research on Pelagic Fish Resources" (IPFC/C49/SYM.2).

29th March, 1949.

SEVENTH SESSION. Commenced at 10.00 a.m. Dr. Baini Prashad in the Chair.

1. *Proposal from ICZN.* The Working Paper IPFC/C49/3 was preferred to. It was moved by Dr. Thompson (Australia) and seconded by Dr. Amirthalingam (Ceylon) that the ICZN be thanked for its suggestion and be informed that the Indo-Pacific Fisheries Council has at present no funds to make available for the proposed purpose and that Technical Committee I be directed to discuss with the ICZN the ways in which work on the problem of standarization, which the Indo-Pacific Fisheries Council regards as urgent, might be initiated.

2. *Report on the Seventh Pacific Science Congress.* The Working Paper IPFC/C49/7 was received and adopted with thanks to Mr. Tweedie for his work in this matter.

3. *Report of Taxonomy Committee.* The Working Paper IPFC/C49/13 was received. The Taxonomy Committee and the others who assisted in the preparation of the report were thanked for their work and the report was handed to Technical Committe I for consideration.

4. *Proposal for Panel of Experts.* The Working Paper IPFC/C49/9 was received. Dr. Thompson (Australia) suggested that the list should be brought up-to-date. Dr. Wolsky (UNESCO) suggested that there should be an addition of experts in physiology and other such subjects. The proposal for a panel of experts was approved in principle.

5. *Survey of Institutions, etc.* The Working Papers IPFC/C49/12 and IPFC/C49/15 were received. The project was approved and the Council requested its continuation and completion.

6. Mr. Herrington gave a talk on "Some Aspects of Japanese Fisheries Work" which was followed by a brief discussion.

7. Dr. Thompson presented his paper entitled "The organisation and utilisation of plankton investigations" (IPFC/C49/CONTR.11).

8. Mr. Durand read his paper on "*Rastrelliger kanagurta* (Ruppel)—Its Fishery and Biology —Summary of our Knowledge—Study Programmes" (IPFC/C49/CONTR.13).

9. Dr. Hardenberg tabled the paper by Dr. J. Zanefield entitled "The Economic Marine Algae of Malaysia".

10. *Proposals for work during ensuing year.* Dr. Panikkar (India) tabled the following proposal from Technical Committee I on the lines along which the Committee might work:

(i) The basic structure of the Council's biological and hydrological programme must be related to national projects of research and development for which the Council would propose measures of co-ordination and integration aimed at ensuring that the projects are complementary to one another and yield a maximum amount of information of common value, from the existing resources of personnel and equipment.

(ii) The Council will need to apprise itself fully of the nature and scope of the national programmes and of the resources available for carrying them out.

(iii) The Council should formulate and recommend programmes of common interest and recommend assignment of priorities. The machinery by which the Council might operate could be as follows:-

(a) Recognition of the interest in and recommendation of allotment of responsibility for geographic and subject units.

(b) Exchange of information on—

1. Methods and equipment,
2. Results,
3. Conclusions,

(c) Formulation and recommendation of standards for research methods, equipment and scientific terminology.

There then followed some discussion on the establishment of the Committees and the manner in which they would work. Dr. Thompson (Australia) stated that his Government was strongly opposed to the setting up of Committees without a reasonable offer of prior advice on their proposed functions and programmes. Mr. Sette (U.S.) suggested the establishment of the Committees in accordance with Section X of the Rules and that the Committees thus appointed should be given firm terms of reference. As a basis for discussion he suggested that the Committee on Hydrology and Biology should concern itself with matters relating to utilizing aquatic resources, the biology and bionomics of aquatic organisms and the dynamics of their populations and that the Committee on technology should concern itself with the capture, preservation, processing, distribution, marketing and utilization of fish and fishery products. After some discussion it was agreed that Mr. Sette's proposal should be adopted and that after re-drafting, some terms of reference should be handed to the two Technical Committees for their consideration and subsequent submission to the full Council for adoption. It was also agreed that the two Committees already appointed should continue to function until Thursday when it was proposed that the Rules having been formally adopted, formal appointment of the Committees and of their office bearers could be carried through.

The meeting adjourned at 12.30.

EIGHTH SESSION. Mr. W. B. Braxton read a paper on "The problem of Fish Storage and Refrigeration in South East Asia" (IPFC/C49/CONTR.14).

2. "Prelimary Report on studies of Salted fish paste", by Mr. J. I. Sulit and Mr. S. B. Santiago (IPFC/C49/CONTR.16) was tabled.

3. Mr. Martin read the paper on "Notes on the experimental canning of fish at the fish preservation station, Estancia, Philippines" (IPFC/C49/CONT. 17).

4. The paper by Mr. Boon Indrambarya entitled "Notes on the effect of explosives on fish in Siamese coastal waters" (IPFC/C49/CONTR.8) was read.

5. *Report on Technical Committee II.* Dr. Amirthalingam presented Work Paper No. IPFC/C49/21) which was discussed generally without any conclusion being reached.

6. Mr. Butler read his paper on the Vitamin A content of Fish Oils.

Meeting adjourned at 4.30 p.m.

In the evening at 6.45 p.m. Delegates attended a Reception given by Sir Franklin Gimson, Governor of Singapore.

30th March, 1949.

NINTH SESSION. Commenced at 10.00 a.m. Dr. Baini Prashad in the Chair.

1. A proposal to make a conference levy of $5 per head was made by the Secretary and agreed to by the Meeting.

2. The Secretary explained the history of the preparation of the handbook "Malayan Fisheries", explaining the origin of the funds for its publication. He stated that he would be grateful for assistance in effecting as wide a sale as possible.

3. Mr. Cater read a paper entitled "An outline of the Preliminary Survey of the Socio-economics of the Fishing Industry of Hong Kong".

In the discussion Dr. Prashad (India) enquired whether there was any evidence on the condition of the stocks as a result of the reduction of fishing since the Japanese left the area and he also asked about rehabilitation of the industry following the destruction of gear and boats by the war. Mr. Cater replied that little was known about the stocks and described steps taken by the Hong Kong Government to rehabilitate the fishermen. Dr. Amirthalingam referred to the effect upon the industry of mechanization of the fleet.

4. Mr. J. A. Tubb gave a short talk on Socio-economics.

Meeting adjourned at 10.50 a.m. to allow Technical Committees to continue discussion of terms of reference and programmes.

TENTH SESSION. Commenced at 2.10 p.m. Dr. Baini Prashad in the Chair.

1. *Terms of reference of Technical Committees.* The draft of terms of reference, circulated in Working Paper IPFC/C49/18, was discussed. Dr. Amirthalingam suggested that, under (b) Committee on Technology, the words "statistics, (4)" should be added after "(5)" (4) should then become (5). Mr. Sette (U.S.) moved the adoption of the terms with the amendment proposed by Dr. Amirthalingam. Seconded by Dr. Amirthalingam (Ceylon). Carried.

2. *Budget and F.A.O Journey's Fund.* The Secretary read a statement from Washington reporting the sums of money provided by F.A.O. for the I.P.F.C. for 1949. There were—

Travel expenses	-	$2,000
Publications	-	$2,000
Stationary, etc.	-	$ 500
		$4,500.

There was discussion on the possibility of transferring sums as between these items and it was presumed that this could be done. Dr. Flory (U.S.) suggested that a formal budget should be prepared setting out the justification for the sums shown. This would enable the Director-General to make a more effective case in submitting these items in the general F.A.O. budget. After some discussion of the difficulty of preparing estimates, it was agreed that a formal budget document would be prepared.

3. *Publications.* The question of printing costs was discussed and Mr. Sette (U.S.) moved and Dr. Hardenberg (Netherlands) seconded "that the Secretary be directed to canvass various publishing houses in the area to ascertain where the Council's publications might be most advantageously published." It was agreed that the Council's basic publication should be the Report of its proceedings and that occasional papers should be prepared and distributed in mimeograph form.

Mr. Tweedie (U.K.) moved and Mr. Sette (U.S.) seconded "that the Council took note of the importance of the book "De Indische Zeevisschen en Zeevisscherij," by Drs. Delman and Hardenberg in any study of the fisheries of South East Asia and welcomed the statement by the U.K. Delegate that H.M. Government contemplated the production of an English translation." Carried.

4. Mr. Lemasson presented his paper, "General review of the Fish and Fish Culture in the Continental waters of Indo-China and the projected programme of work".

5. *Rules of Procedure (Agenda Item 9)* (Working papers IPFC/C49/2 revised, and IPFC/C49/19: Report of Secretary on drafting of rules).

Section I. Mr. Sette (U.S.) moved, and Dr. Amirthalingam (Ceylon) seconded, the adoption of this Section. Carried.

Section II. Mr. Martin (Philippines) moved, and Dr. Amirthalingam (Ceylon) seconded, the adoption of this Section. Carried.

Section III. Dr. Panikkar (India) moved, Mr. Sette (U.S.) seconded, that this section be adopted with deletion of the words "at each meeting" from the end of the last line. Carried.

Section IV. Mr. Sette (U.S.) moved, and Mr. Lemasson (France) seconded, the adoption of this Section. Carried. There was discussion of the word "available" in para. 3.

Section V. Dr. Amirthalingam (Ceylon) moved, and Mr. Sette (U.S.) seconded, that this section be adopted. Carried.

Section VI. Mr. Sette (U.S.) moved, and Mr. Martin (Philippines) seconded, that this Section be adopted. Carried.

Section VII. Dr. de Jong (Netherlands) moved, and Mr. Martin (Philippines) seconded, that this section be adopted. Carried.

Section VIII. Mr. Sette (U.S.) moved, and Dr. Panikkar (India) seconded, that this section be adopted. Carried.

Section IX. Mr. Martin (Philippines) moved, and Mr. Sette (U.S.) seconded, that this section be adopted. Carried.

Section X. Dr. Deason (U.S.) moved that the second sentence of para. 2 be deleted and that the terms of reference, adopted during Session Nine, be incorporated in Section X, perhaps as paragraph 3. Dr. Clyde (U.K.) said that he would like to know more about the reason for the proposal for he failed to see its object. Dr. Deason replied that it was a matter of having all the Council's machinery in one place. Dr. Clyde considered that adequate provision was made in the Council's Rules for determining and adjusting the terms of reference of the committees. Dr. Deason then said he would like to withdraw his motion and suggest an alternative to the effect "delete the period after Council

and add the words 'and attached as an appendix to the Rules' ". Dr. Clyde agreed to the point that it was desirable that whenever the rules are read the Committee's terms of reference should be read with them. It was then suggested that the period at the end of the second sentence should be replaced by a comma to be followed by the words "and shall always be published along with these Rules."

Moved by Mr. Sette (U.S.) and seconded by Dr. Clyde (U.K.) that with the last proposed amendment para. 2 of this section be adopted.

Dr. Thompson (Australia) moved that the words "and the Secretary" be deleted from the second line and replaced by the words "one other member", and added that of course the Secretary should attend ex-officio.

Dr. Kask (F.A.O.) stated that the Director-General wished to make someone in a policy-making position directly responsible to himself in the matter of expenditure of funds.

Dr. Flory (U.S.) joined issue with Dr. Kask on the propriety of this view. He considered it inappropriate that a person who was not in a command position in the Council should hold such a position in the Executive Committee. Dr. Clyde (U.K.) suggested that the difficulty lay perhaps in the fact that the Executive Committee had powers under Section X(1)b which were too wide, he thought that possibly the Australian objection would be met by the modification of this sub-paragraph. Dr. Flory pointed out that in any case the Secretary exercised a supervision of the funds under another section so that Dr. Kask's principle requirement was thus met.

Meeting adjourned at 4.45 p.m.

At 5.55 the members attended a showing of the F.A.O. film "Battle for Bread".

At 8.30 they attended the third session of the Symposium at which Dr. J. D. F. Hardenberg presented a paper on "The Development of Pelagic Fisheries" and Mr. H. W. Warfel read a paper on "Notes on the Pelagic Fisheries of the Philippines with particular reference to Tunas" by H. W. Warfel and C. B. Wade.

31st March 1949.

ELEVENTH SESSION. Commenced at 10.15 a.m. Dr. Baini Prashad in the Chair.

1. *Rules of Procedure (resumed). Section X, para.* 1.

Dr. Thompson (Australia) moved, and Dr. Amirthalingam seconded, that the words "and the Secretary" be deleted from the second line of para. 1 of Section X and "and" after "Chairman" be inserted in the first line, deleting the comma which follows the word "Chairman": that the first line of para. 2 of Section V be altered to read "The Secretary or his representative shall attend all meetings of the Council and its Executive Committee and his duties shall include....." "

Dr. Clyde (U.K.) sought permission to move an amendment as follows:

"Amend Section X (1) (b) by substituting a comma" for the period after "meetings" and adding: "except that issues of policy, unless previously decided by the Council, shall be formulated by the executive Committee as a motion and referred to the Member Governments. Upon receipt by the Secretary of affirmative replies from a majority of the Members Governments, the motion shall be considered adopted."

The Chairman ruled that the substance of Dr. Clyde's proposal was so very different from that of the Australian motion as to constitute a separate motion. Dr. Clyde then obtained permission to explain his position. He said that he was fully in sympathy with the Australian view but believed that his own suggestion was a better solution to the problem which, as he had said previously, seemed to be a question of the measure of policy determination which might be undertaken by the Executive Committee. Dr. Panikkar (India) demurred at the delays which would result from procedures such as proposed by the U.K. Dr. Thompson (Australia) supported this view; he went on to say that whilst the Members of the Council might be satisfied with the present Secretary, there was no guarantee that he might not be replaced by a less competent person. Dr. Clyde considered these arguments were not very strong. After some further discussion during which Mr. Sette (U.S.) asked the Chairman whether he would not revise his decision in respect of the U.K. request to submit a motion for amendment of the

Australian motion, which the Chairman declined to do, and Dr. Thompson referred to the control over finance held by the Secretary under Section V (2), Mr. Sette made a statement that although the U.S. Delegation had itself raised this question previously it now, in view of Dr. Kask's statement and of the U.K. proposal, found itself unable to support the Australian motion.

The motion was then put: For 3 against 5. Dr. Clyde (U.K.) then moved his motion (given above), and Mr. Sette (U.S.) seconded.

The motion was put to the vote: For 5 against 1. Australia, Ceylon and India refrained from voting.

Section XI. Dr. Amirthalingam (Ceylon) moved, and Mr. Sette (U.S.) seconded, that this section be adopted. Carried.

Section XII. Mr. Martin (Philippines) said: "The desirability is recognised of making provision in the rules of procedure that would make it possible in certain very exceptional cases to invite non-members Government who are not members of the Food and Agriculture Organization to attend meetings of the Council, provided that there is assurance that the extending of such an invitation expressed the will of a substantial majority of the Member Governments. Therefore it is moved that Section XII of the Rules of Procedure be amended by inserting a new paragraph as follows: "3. On an affirmative vote of three fourths of all of the Members Governments, invitations to be represented by Observers shall be sent to non-member Governments which are not members of the Organisation." It is further moved that present paragraph 3 of Section XII be re-numbered as paragraph 4."

The motion was seconded by Mr. Sette (U.S.) Mr. Whang (Korea) expressed his gratitude for the motion since, although the Agreement provided means whereby his Government might become a member of the IPFC, the steps towards that end might well be delayed. The insertion of the proposed addition to the Rules would permit his Government to be invited. Dr. de Jong (Netherlands) said that he had no objection provided notice was given early enough. The motion was carried.

Mr. Martin (Philippines) moved, and Dr. Amirthalingam seconded, that Section XII, as amended in accordance with previous resolution, be adopted. Carried.

Section XIII. Mr. Sette (U.S.) moved and Mr. Martin (Philippines) seconded, that this section be adopted. Carried.

Section XIV. Dr. Panikkar (India) moved and Dr. Thompson (Australia) seconded, that this section be adopted. Carried.

Section XV. Mr. Sette (U.S.) moved, and Dr. Clyde (U.K.) seconded that the second version of paragraph 2 be adopted. Carried. Dr. de Jong (Netherlands) moved, and Dr. Amirthalingam (Ceylon) seconded, that Section XV as amended be adopted. Carried.

Section XVI. Dr. Thompson (Australia) proposed that the figure "24" be replaced by "48" in line 6 of para. 1; Mr. Martin (Philippines) moved, and Mr. Sette (U.S.) seconded, that Section XVI as amended be adopted. Carried.

Section on "Official Languages". Mr. Lemasson (France) moved, and Mr. Sette (U.S.) seconded, that the new section submitted in connection with official languages be adopted as Section XVII. Carried.

Dr. Amirthalingam (Ceylon) moved and Dr. de Jong (Netherlands) seconded, that the Rules of Procedure as considered, amended and adopted in these Sessions be adopted as the Rules of the Council. Carried.

Mr. Sette (U.S.) moved the adoption of the Secretary's report on drafting the Rules of Procedure (Working Paper IPFC/C49/19). Dr. de Jong seconded. Carried.

2. *Budget.* A statement on Budget was submitted by the executive Committee. This was discussed and it was directed that (a) the sums shown should add to the total figure required, (b) that the preamble should be amended to indicate that the Council expected its activities to expand and require greater funds. Dr. Clyde (U.K.) moved that with these amendments, the Budget statement be approved. Mr. Martin (Philippines) seconded. Carried. (The statement is given as Appendix 3).

3. *F.A.O. Journey's Fund.* Dr. Thompson (Australia) moved: "the Council expresses its appreciation and thanks to the United Kingdom for the services it has made available in connection with the F.A.O. Journey's Fund, but considers that at the earliest possible moment steps should be taken to provide fully for the Council's secretarial services out of a single consolidated fund."

Dr. de Jong (Netherlands) seconded. Further discussion and decision were deferred because the U.S. Delegation announced its wish to submit an alternative motion.

4. *Place of next regular meeting:* Dr. Thompson (Australia) said he thought is was doubt-

ful whether the Council was in a position to decide the most appropriate locale for the next regular meeting and moved that decision be left to the Executive Committee. Dr. Panikkar (India) seconded. Carried.

5. *Credentials.* The Secretary read his report (Appendix 4). Dr. Panikkar (India) moved and Mr. Martin (Philippines) seconded the adoption of the Secretary's report. Carried.

6. *Election of Chairman.* Dr. Clyde, nominated Dr. Prashad and requested that the remarks which he made at the first session when nominating Dr. Prashad at that time, be taken as read again at this juncture (see p. 4.). Dr. Amirthalingam, seconded. Mr. Sette (U.S.) moved that nominations be closed. Dr. de Jong (Netherlands) seconded. Carried.

7. *Nomination of Vice-Chairman.* Mr. Sette (U.S.) nominated Dr. Hardenberg and wished his earlier remarks to be read here (see p. 4.). Dr. Amirthalingam (Ceylon) seconded. Dr. Thompson (Australia) moved that nominations be closed, Dr. Panikkar (India) seconded. Carried.

Meeting adjourned at 12.15 p.m.

TWELFTH SESSION. Commenced at 2 p.m. Dr. Baini Prashad in the Chair.

1. *Technical Committees.* The Secretary presented the list of names of persons nominated by the Delagations and who thus, in accordance with Section X (2) a, constituted the Technical Committees, further names were added to the circulated list and the final list was as given in the front of this report.

The members of the Committees present then withdrew to elect officers and returned to announce the following results:

Committee I—Chairman: Dr. Panikkar
Rapporteur: Mr. Schuster

Committee II—Chairman: Dr. Amirthalingam
Rapporteur: Mr. Martin.

On the question of the activities of the Technical Committees; Dr. Panikkar on behalf of Technical Committee I presented the Committee's report, IPFC/C49/20.

Mr. Sette (U.S.) said that part I of this paper was a proposal of the matters of which the Committees should take cognizance in their work, whilst parts II and III were definite proposals for action. He moved, and Mr. Martin (Philippines) seconded, that "the Committees, and their sub-committees on particular problems, should take cognizance of and be guided by the following:—

1. The basic structure of the Council's biogical and hydrological programme must be related to national projects of research and development for which the Council would propose measures of co-ordination and integration aimed at ensuring that, wherever possible, the projects are complementary to one another and yield a maximum amount of information of common value from the existing resources of personnel and equipment.

2. Each Committee will need to apprise itself fully of the nature and scope of the national programmes and of the resources available for carrying them out.

3. Each Committee, as a working unit, should formulate and state the specific problems referred to it and recommend assignment of priorities in the working programme, taking into consideration where appropriate:—

   (a) Recognition of the extent of interest of Member Nations in geographic and subject units.

   (b) Exchange of information on
      1. Methods and equipment
      2. Results
      3. Conclusions.

   (c) Adoption of standard methods of equipment and terminology." Carried.

Dr. Thompson (Australia) then moved, and Dr. de Jong (Netherlands) seconded, that. "With the objective of securing information useful in facilitating the development of high seas fishery resources and recognizing that co-ordinated efforts would be desirable to this end, the council requests the Committee on Hydrology and Biology to explore the opportunities for collaboration by members of the Council in the study of the tuna fishery resources, and to report and make recommendations thereon to the Council at its next regular session." Carried.

Dr. Hardenberg (Netherlands) moved, and Dr. Panikkar (India) seconded, that: "With the objective of increasing the output of fisheries concerned with the commercially important Clupeids, Engraulids, Scombroids (other than tuna) and Carangids, the Council requests the Committee on Hydrology and Biology to explore the possibilities of programmes of co-ordinated research, including a survey of existing

resources and the means of judicious exploitation, and to report to the Council with specific recommendations, if any, at its next regular session." Carried.

Dr. Panikkar (India) moved, and Mon. Lemasson (France) seconded, that: "With the objective of securing scientific information useful to the development of fish culture in fresh and salt water, the Council requests the Committee on Hydrology and Biology to explore the opportunities for collaboration by members of the Council and to report and make recommendations thereon to the Council at its next regular session." Carried.

Dr. Amirthalingam (Ceylon) presented work Paper IPFC/C49/21 on behalf of Technical Committee II. The Committee had wished him to suggest to the Council that its programme should be as set out in this paper. He therefore moved that the House resolve that Technical Committee II be requested to make a survey of the local gear and boats with descriptive details so that they may be of benefit to other members of IPFC. This motion lapsed and in its place Mr. Sette (U.S.) moved: "with the objective of securing information useful in further the development and proper utilisation of the fisheries, the Council requests the Committee on Technology to investigate the extent to which surveys can be be made by Member Government of the Council recording the local boats and gear with descriptive details." Mr. Sette explained that his Delegation felt that there was difficulty in the implication that the Committee should carry out a survey. Not only would the Committee find this difficult but so would the countries themselves.

Dr. Amirthalingam (Ceylon) seconded the U.S. motion which was put and carried.

Dr. Amirthalingam then suggested the adoption of a similar motion in respect of Parts (2) and (3) of Section I of para. 5 of IPFC/C49/21. There was much discussion of this and finally, with general agreement a motion was drafted by Dr. Clyde to incorporate these parts with the U.S. motion. Dr. Clyde (U.S.) moved, and Dr. Amirthalingam seconded, that: "With the objective of obtaining information useful in forwarding the development and proper utilisation of the fisheries in the Indo-Pacific Area, the Council requests the Committee on Technology to investigate the extent to which surveys of local boats and gear, with descriptive details, have been made and recommends to Member Governments that further surveys of this sort be made. The Council further requests the Committee of Technology to prepare a report on this subject for presentation to the Council at its next Meeting. The Council also requests the Committee on Technology to investigate the extent to which non-indigenous gear is employed and the possibilities of its further useful employment in the Indo-Pacific areas and to seek from Member Governments such information as is now available on non-indigenous gear and other methods and on net efficiency and preservation, and prepare a report on this subject for presentation to the Council at its next regular session." Carried.

Dr. Amirthalingam (Ceylon) moved, Mr. Sette (U.S.) seconded, that "with the objective of securing information useful in forwarding the development and proper utilization of the fisheries of this area, the Council requests the Committee on Technology to investigate the extent to which surveys have been made of processing industries and to seek from them reports on the canning, packaging and refrigeration of fish in their countries and on the by-products from these industries." Carried. (*This covers Section II of para 3 of IPFC/C49/21*).

It was agreed that Section III of para. 3 of IPFC/C49/21 should be regarded as a suggestion for an agenda item for the next regular meeting. It was moved by Mr. Sette (U.S.) and seconded by Mr. Martin (Philippines), that "Section III of para. 3 of IPFC/C49/21 be placed on the agenda of the next regular meeting." Carried.

In discussion of para. 4 of IPFC/C49/21 reference was made to the status of the proposed panel. It was finally agreed that the present suggestion be withdrawn until the Committees had examined and reported more fully on the proposal for the panel, which was approved in principle during the Seventh Session, Item 4.

2. *F.A.O. Journeys Fund.* The motion submitted by Dr. Thompson (Australia) and seconded by Dr. de Jong (Netherlands) (see above p. 16), was put and carried.

3. *Items for the Agenda.* The only referred item is that in connection with para. 4 of IPFC/C49/21.

4. *Recommendations to Member Governments.* Attention was drawn by the Chairman to the motion adopted during the Tenth Session (item 3) in connection with the translation of the book by Drs. Delsman and Hardenberg (see p. 14).

5. *Votes of Thanks.* Mr. Sette (U.S.) moved, Dr. Amirthalingam (Ceylon) seconded, that "The IPFC expresses its gratitude to the Government of the U K. through the Commissioner-General for the U.K. in S.E. Asia and the Government of Singapore for inviting the Council to hold its first meeting in Singapore and for the continuing courtesies and assistance which the Commissioner-General and his staff have accorded the Council. The Council also expresses its gratitude to the principal and staff of the King Edward VII College of Medicine for providing facilities for its sessions," and that these

expressions "be suitably inscribed and transmitted by the Secretary to appropriate individuals" and that "the Indo-Pacific Fisheries Council commends its Secretary for his keen foresight in anticipating the needs of the Council and his untiring efforts in developing the preparatory work for its first meeting. The Councils considers that the Secretary's initiative and energy have made substantial contributions towards the success of the Council to date. The Council further commends him and his staff for the competent manner in which they have arranged and provided services for this Meeting" and that "the Secretary is instructed to transmit a copy of his Resolution to the Director-General." Carried.

The Chairman said he wished to offer his personal appreciation not only of assistance from delegates but also from the staff and was sure that "if we carry on in this way our work of the next session will be so much smoother and give very pleasant results. I would particularly like to express my personal appreciation to Dr. Deason and Dr. Flory for their efforts and the labour that they have expended in helping us in the task of drafting our Rules of Procedure and all the other work required in guiding us along the right lines."

Dr. Clyde on behalf of the U.K. Government, regarding the first part of the Resolution moved by Mr. Sette, "I would like to say what a pleasure it has been to act as first host to the Meeting of the Council and to assure you that the U.K. Government will do everything it can to help make the work of the Council a success."

6. *Film.* Dr. Thompson (Australia) showed three reels of film on laboratory techniques in Hydrology.

7. Closure. The Chairman declared the meeting closed at 4.15 p.m.

The Chairman entertained the representatives and secretariat at afternoon tea.

In the evening at 6.30 p.m., members attended a Reception given by the Honourable Malcolm MacDonald, Commissioner-General for the U.K. in South East Asia, at Bukit Serene.

Technical Committee Meetings. In addition to the Council Sessions reported in this record Technical Committees I and II (provisionally constituted until the Twelfth Session) met on various occasions, notably at 9 a.m. on Saturday March 26th (both), 9.00 a.m. on Monday March 28th (Committee I), 9.00 a.m., on Tuesday, March 29th (both), 9.00 a.m. and again at 11.30 a.m. on Wednesday March 30th and at 2.30 p.m. on Thursday, March 31st (both).

Appendix 3.

BUDGET

The Executive Committee has considered the question of expenses of the Council, as provided for by Article VI of the Agreement, and has taken cognizance of the information received from the Head Office of the Organization. It finds some difficulty in submitting a Budget at this stage and considers that even if the sums now available should prove adequate for 1950, it is certain that the Council's activities will expand in subsequent years and require larger funds.

Travel Expenses: On the basis of holding two meetings of the Executive Committee between this and next regular meeting and allowing only for one meeting to be held in Calcutta and the other in Batavia, the fares and travel expenses of the officers have been roughly calculated at about $1850 (U.S.) and a further sum of $150 would be required for contingencies. It is thought that the provision of at least this amount for 1950 would be essential.

Publications: Whilst there is no precise information on costs of publications or of the amount of material which the Council might wish to consider for publication, the available information suggests that the sum of $2,000 (U.S.) should be adequate to publish, during 1949, a report of the present meeting together with a selection of the papers presented and titles and abstracts of remaining papers. Other papers might be circulated in mimeograph form and the same procedure might be followed with preliminary material which might develop out of the Committee's activities. It is suggested that the Report of the Proceedings of the Council's Meetings be made the basic publication of the Council and that this be supplemented by mimeograph publication of other material. The question of other formal publications, such as a journal of the Council, might be considered later. If this plan is accepted, it would be found, the Executive Committee thinks, that the sum of $2,000 would be adequate in 1949 and 1950.

Stationery etc: The Executive Committee feels that $500 is an adequate provision for 1949 and probably for 1950.

Appendix 4.

SECRETARY'S REPORT ON CREDENTIALS

The Secretary wishes to report that he has received credentials, letters of appointment and other means of identification, which satisfy him that the persons named in the first section of the circulated list of representatives are properly appointed to represent their respective Governments as Delegates, Alternates and Advisers. He has also seen similar documents which satisfy him that the persons named in the second part of that list as Official Observers are properly appointed to act in that capacity. Finally he wishes to report that he invited certain local persons, by virtue of their technical qualifications, to assist in these discussions; this was done in the absence of adopted Rules of Procedure and he requests that his action may, in this instance, be approved.

Appendix 5.

SECRETARY'S REPORT ON THE PROPOSED RULES OF PROCEDURE

The Secretary obtained the assistance of Dr. Flory and Dr. Deason in carrying out the Council's direction to draft the Rules of Procedure in accordance with the discussions which took place in the 2nd, 3rd and 4th sessions, and the special session on Saturday afternoon. A revision of the rules in literal accord with the discussions which took place was prepared and used as a basis for re-drafting from the point of view of language alone. Numerous alterations were found desirable in this sense and in addition certain other changes were indicated in the course of discussions with delegations. A complete revision is submitted herewith and the following explanation of the changes made is offered.

1. The Sections of the rules are designated as "Sections" instead of "Rules" for euphony in reference.

2. The order of the definitions has been changed to allow of simplification in the wording of the definitions.

3. The expression "Member Government" has been substituted for "Member of the Council" as a means of indicating more clearly that the Council is composed of Member Governments, and to distinguish clearly between the Governments and their delegates.

4. Definitions have been inserted for the expressions "Observer Government or Organization" and "Observer" to permit simplification of wording. It will be observed, that, by these definitions and by reference to Section XII the expression "to such other Governments, Organizations and International bodies as are to be invited to participate in the meetings" has been eliminated. A definition has also been inserted for the term "Delegate."

5. The term "Sessions" has been employed in the sense of the actual meeting during any morning, afternoon or evening and the term "Meeting" to mean a series of sessions of the Council and its Committees.

6. Section II (1): The responsibility for calling the meeting has been changed from the Secretary to the Chairman, in accordance with Art. II (5) of the Agreement. It is understood that the Secretary may send out the actual communications constituting the "consultation" and the actual invitations in the name of, and at the request of, the Chairman.

It is understood that the expression "consultation" is intended to mean that in determining the time of a meeting the Chairman shall notify Member Governments of his proposal as to the date of the meeting, and after allowing a reasonable time for the Governments to reply, he will make a decision based on the replies received up to that time.

7. Section II (2): Drafting changes only.

8. Section II (3): Drafting changes only.

9. Section III: Drafting changes; in addition the time requirement has been removed for practical reasons; the words "for action by the Council" give an adequate protection and were inserted to show that the Council must approve the credentials.

10. Section IV: Drafting changes, in that the items which it is mandatory to include on the provisional agenda are grouped in paragraph 1, and these categories for which items may be proposed are included in paragraph 2; the original paragraph 1 has been included here.

Two new items have been included "(a) Adoption of Agenda" and "(b) Reports of Committees"; under the former the Council will indicate its approval of items proposed in accordance with paragraph 2.

11. Section IV (3): Drafting changes, in that paragraph 3 and 4 have been combined. A time limit for receipt of items for the provisional agenda in accordance with paragraph 2, is given. The exception in respect of "Rule XV, paragraph 2" has been removed as being inapplicable; also see the alternative wordings offered for Section XV (2).

12. Section IV (4): This is a new paragraph relating to the agenda for special meetings. It will be noted that under this paragraph as proposed, special meetings could consider only these special and urgent matters which impelled the calling of the meeting.

13. Section V (1) and (2): Definition of "Secretariat" has been inserted since it is used elsewhere in the Rules. The expression "as the facilities of his office permit" has been excluded because it is unnecessary. The limitations of finances to support the Secretariat are understood and the determination of priorities in the work of the Secretariat properly is a function of the Council and the Executive Committee. Drafting changes only in paragraph 2.

14. Section V (3): Re-arrangement has been effected and an indication has been given of where the responsibility lies for sending copies of correspondence to the Secretary. It is presumed that this provision applies only in respect of correspondence by persons acting on behalf of the Council, (the Chairman, Vice-Chairman, Chairman and members of Committee etc.), but it is also presumed that steps would be taken in most cases to furnish the Secretary with copies of correspondence to which this provision does not apply.

15. Section VI: Drafting changes only.

16. Section VII (1): Drafting changes only.

17. Section VII (2): It is proposed that the Chairman and Vice-Chairman assume office at the end of a regular meeting and hold office until the end of the next regular meeting, as originally proposed, in order that the officers may provide continuity in connection with the plans and programmes they have developed between meetings.

18. Section VIII (1): Drafting changes. The Chairman has been given the power to appoint the members of such special committees as the Council may set up to function during the meeting only.

19. Section VIII (2): Changed to permit the Chairman to relinquish the chair in order to speak or act for his Government.

20. Section VIII (3): Changed to provide that designation of the representative in place of the Chairman or Vice-Chairman is left to the discretion of the Delegation in accordance with its instructions.

21. Section VIII (4): The provision of the original paragraph 4 relating to the Vice-Chairman's assumption of the functions of the Chairman in his absence, is contained in paragraph 2. The provision for election of a new Chairman, in the event of the previous Chairman being unable to continue in office has been dropped and there has been added a provision for the Secretary to act in the admittedly remote possibility of both the Chairman and Vice-Chairman becoming unavailable for the affairs of the Council. This new paragraph is accordingly offered.

22. Section IX: Drafting changes only.

23. Section X: Drafting changes only.

24. Section X (2): Drafting changes only.

25. Section X (2) (d): Drafting changes, in that the words "ad hoc" have been substituted for the word "interim".

26. Section XI (2): Drafting changes in that "proposed budget" has been inserted instead of the words "Estimates of Exchanges" as being more precise designation of the type of document with which the Council will be concerned; and paragraphs 2 and 3 have been combined.

27. Section XI (4): A re-wording of the original paragraph 6 is submitted to indicate more precisely the nature of the Secretary's responsibility in connection with wishes of Member Governments in respect of co-operative or joint research in so far as the council may be involved.

28. Section XII (2): A new paragraph has been been inserted here to provide for the intention of the original paragraph 4 of Section II. It will be observed that only international organizations are included. It is the view of the U.S. Delegation that organizations other than international organizations may not properly be invited as Observers, and that national organizations might be included either in delegations or as advisers to the Secretariat for the particular meeting.

29. Section XII (3): Drafting changes. Observers are permitted to attend any technical Committee sessions except when the Committee declares itself to be in executive sessions.

30. Section XIII: Drafting changes and requirement of summary records of all Committee meetings.

31. Section XIII (2) and (3): Drafting changes, except that in (2) the records and reports and other documents shall be sent to Observer Governments and Organizations as well as to the Member Governments.

32. Section XIV: Drafting changes only.

33. Section XV (1): The wording has been made it explicit that copy of proposals for amendment shall be sent to Member Governments and to the Director General upon receipt by the Secretary.

34. Section XV (2): Alternate wording is offered; It will be observed that originally a margin of 90 days was allowed between notice by the Secretary and the meetings to assure that the Member Governments would have adequate time to consider the proposal. Since the provisional agenda for regular meetings must now be sent out 60 days in advance of the meeting it may be that the extra 30 days allowed under the first alternative would not be essential. Adoption of the second alternative would simplify the work of the Secretariat.

35. Section XV (3): It is suggested that the sequence of steps to be followed in connection with proposals of this kind should be clearly indicated and that the wishes of the Member Governments should be determined before the approval of the Conference should be sought.

36. Section XVI (1): Drafting change, except that in addition to distribution beforehand announcement of the proposal is now required at least 24 hours before action is taken.

37. Section XVI (2): Same as Section XVI (1).

38. Section XVI (3), (4): Drafting changes only.

RULES OF PROCEDURE
REGLEMENT INTERIEUR.

SECTION I.

For the purpose of these Rules, the following definitions apply:

Agreement:	The Agreement for the Establishment of the Indo-Pacific Fisheries Council, formulated at Baguio, Philippines, 26th February 1948.
Council:	The Indo-Pacific Fisheries Council.
Chairman:	The Chairman of the Council.
Delegate:	The representative of a Member Government as specified in Article II(1) of the Agreement.
Delegation:	The delegate and his alternate, experts and advisers.
Member Government:	The Member Government of the Council.
Secretary:	The Secretary of the Council.
Organization:	The Food & Agriculture Organization of the United Nations.
Conference:	The Conference of the Organization.
Director-General:	The Director-General of the Organization.
Observer Government or Organization:	A non-Member Government or Organization invited to attend a meeting of the Council.
Observer:	The representative of an Ob server Government in Organization.

ARTICLE I.

Aux fins du présent règlement, les termes se définissent comme suit:

Accord:	L'Accord en vue de la constitution d'un Conseil Indo-pacifique des peches, conclu a Baguio (Republique des Philippines), le 26 fevrier 1948.
Conseil:	Le Conseil indo-pacifique des peches.
President:	Le President du Conseil.
Delegue:	Le representant d'un Etat Membre comme il est specifie dans l'Article II(1) de l'Accord.
Delegation:	Le delegue et son suppleant, les experts et les conseillers.
Etat Membre:	L'Etat Membre du Counseil.
Secretaire:	Le Secretaire du Conseil.
Organisation:	L'Organisation des Nations Unies pour l'Alimentation et l'Agriculture.
Conference:	La Conference de l'Organisation..
Directeur general:	Le Directeur general de l'Organisation.
Etat ou organisation represente par un observateur:	Un Etat ou une organisation non-membre invite a assister a une session du Conseil.
Observateur:	Le representant d'un Etat ou d'une organisation agissant en tant qu'observateur.

SECTION II.

Meetings of the Council

1. In pursuance of, and in accordance with Article II (5) of the Agreement the Chairman shall issue invitations calling the regular meeting of the Council in the first quarter of each year at such time as he may determine, after consultation with the Member Governments, and at a place decided upon by the Council at a previous meeting, or as decided by the Executive Committee and subsequently approved by a majority of the Member Governments.

2. The Chairman may call a special meeting of the Council at

(a) the direction of the Council

(b) the direction of the Executive Committee with the approval of a majority of the Member Governments, or

(c) the request of a majority of the Member Governments.

The Executive Committee shall decide the time and place of such a meeting.

3. Invitations to a regular meeting of the Council shall be issued not less than sixty days in advance of the date fixed for the opening of the meeting. Invitations to Special Meetings shall be issued not less than forty days in advance of the date fixed for the opening of the meeting.

SECTION III.

Credentials

At each meeting the Secretary shall receive the credentials of the Delegations and Observers and shall examine and report thereon for action by the Council.

SECTION IV.

Agenda

1. The agenda of each regular meeting shall include:

(a) Adoption of the agenda.

(b) The election of the Chairman and Vice-Chairman as provided for under Article III (3) of the Agreement.

ARTICLE II.

Sessions du Conseil

1. Conformément à l'Article II (5) de l'Accord, le Président enverra les invitations aux sessions ordinaires du Conseil durant le premier trimestre de chaque année à la date qu'il choisira, après avoir consulté les Etats Membres, et à l'endroit qui aura été fixé, soit par le Conseil au cours d'une réunion antérieure, soit par le Comité exécutif, et approuvé ensuite par la majorité des Etats Membres.

2. Le Président peut convoquer une session extraordinaire du Conseil:

(a) sur les instructions du Conseil

(b) sur les instructions du Comité exécutif avec l'approbation de la majorité des Etats Membres, ou:

(c) à la demande de la majorité des Etats Membres.

Le Comité exécutif décidera de la date et du lieu de cette session.

3. Les invitations à une session ordinaire du Conseil seront envoyées au moins 60 jours avant la date fixée pour l'ouverture de celle-ci. Les invitations à une session extraordinaire seront envoyées au moins 40 jours avant la date fixée pour l'ouverture de celle-ci.

ARTICLE III.

Pouvoirs des delegues

A chaque session le Secrétaire recevra les pouvoirs des délégations et des observateurs et examinera le rapport rédigé à ce sujet et destiné au Conseil pour que celui-ci prenne les décisions nécessaires.

ARTICLE IV.

Ordre du Jour

1. L'ordre du jour de chaque session ordinaire comprendra:

(a) l'adoptation de l'ordre du jour.

(b) l'élection du Président et du Vice-Président comme il est prévu par l'Article II (3) de l'Accord.

(c) A report by the Secretary of the work performed on behalf of the Council by Secretariat.

(d) A report by the Secretary on the financial affairs of the Council.

(e) Consideration of the proposed budget for the ensuing year.

(f) Proposals for amendments to the Agreement, in accordance with Article VII of the Agreement and provisions of Section XV of these Rules.

(g) Applications for membership, approved by the Conference in accordance with Article VIII (2) of the Agreement, from Governments which are not members of the Organization.

(h) Reports of committees.

2. The agenda shall also include, upon approval by the Council:

(a) Items approved at the previous meeting.

(b) Items proposed by the Executive Committee.

(c) Items referred to the Council by the Organization or the Director-General.

(d) Items proposed by a Member Government.

3. A provisional agenda, consisting of items (a) to (h) of para. 1 of this Section and of such other items as may have been proposed, shall be sent by the Secretary to Member Governments and Observer Governments and Organizations not less than sixty days before the date fixed for the opening of the meeting together with reports and documents available in connection therewith.

4. The agenda of the Special Meeting shall consist only of items relating to the purpose for which the meeting was called.

SECTION V.

The Secretariat

1. The Secretariat shall consist of the Secretary and the staff responsible to him and shall provide secretarial services for the Council.

(c) Un rapport du Secrétaire sur les travaux accomplis pour le Conseil par le Secrétariat.

(d) Un rapport du Secrétaire sur la situation financière du Conseil.

(e) L'examen du projet de budget pour l'exercice suivant.

(f) Les propositions d'amendement à l'Accord, conformément à l'Article VII de ce dernier, et aux dispositions de la Section XV du Réglement.

(g) Les demandes d'adhésion au Conseil présentées par des Etats non-membres de l'Organisation et approuvées par la Conférence conformément à l'Article VII (2) de l'Accord.

(h) Les rapports des comités.

2. L'ordre du jour comprendra également, après approbation du Conseil:

(a) Les questions approuvées au cours de la session précédente.

(b) Les questions proposées par le Comité exécutif.

(c) Les questions soumises au Conseil par l'Organisation ou par le Directeur général.

(d) Les questions proposées par un Etat Membre.

3. Un ordre du jour provisoire comprenant les questions (a) à (h) du premier alinéa du présent article, et celles qui auront pu être proposées, sera envoyé par le Secrétaire aux Etats Membres et aux Etats et organisations jouant le rôle d'observateurs, au moins 60 jours avant l'ouverture de la session, en même temps que les rapports et tous documents concernant les dites questions.

4. L'ordre du jour des sessions extraordinaires ne comprendra que les questions qui doivent faire l'objet de la session.

ARTICLE V.

Secretariat

1. Le Secrétariat, composé du Secrétaire et du personnel placé sous son autorité, assiste le Conseil dans le domaine qui lui est propre.

2. The duties of the Secretary shall include the receipt, collation and circulation of documents, reports and resolutions of the meetings of the Council and its committees, the preparation of the records of their proceedings, the certication of expenditures and financial commitments, and the performance of such other duties as the Council or the Executive Committee may direct.

3. The originator shall send to the Secretary for information and record, copies of correspondence concerning the affairs of the Council.

SECTION VI.

Plenary Sessions of the Council

Plenary sessions of the Council shall be open to attendance by all Delegations of Member Governments and Observers, and shall be open to the public unless otherwise decided by the Council.

SECTION VII.

Election of Chairman and Vice-Chairman

1. The Council shall, during each regular meeting, elect the Chairman and Vice-Chairman of the Council for the ensuing year. Nominees shall be duly proposed and seconded from the floor and must be delegates or alternate delegates.

2. The Chairman and Vice-Chairman shall assume office at the end of the regular meeting in which they are elected. They shall be eligible for re-election.

SECTION VIII.

Functions of the Chairman and Vice-Chairman

1. The Chairman shall exercise the functions conferred on him elsewhere in these Rules, and in particular shall:

(a) Declare the opening and closing of each plenary session of the Council.

(b) Direct the discussions at such sessions and ensure observance of these Rules, accord the right to speak, put questions and announce decisions.

2. Le Secrétaire aura pour fonctions de recevoir, rassembler et assurer la diffusion des documents, des rapports et des résolutions prises au cours des sessions et émanant du Conseil et de ses comités, de préparer les comptes rendus des séances, d'approuver les dépenses et les engagements financiers et enfin de s'acquitter de toutes tâches dont le Conseil ou le Comité exécutif pourraient le charger.

3. Des copies de toutes lettres relatives aux affaires du Conseil sont adressées au Secrétaire aux fins d'information et de classement.

ARTICLE VI.

Reunions plenieres du Conseil

Les réunions plénieres du Conseil sont ouvertes à toutes les délégations des Etats Membres et aux observateurs ainsi qu'au public, à moins que le Conseil n'en décide autrement.

ARTICLE VII.

Election du President et du Vice-President

1. A chaque session ordinaire le Conseil élit le Président et le Vice-Président du Conseil pour l'année suivante. Les candidats doivent être des délégués ou des suppléants et leurs candidatures doivent être proposées et appuyées par des membre du Conseil.

2. Le Président et le Vice-Président entrent en fonctions à la fin de la session ordinaire au cours de laquelle ils auront été élus. Ils sont rééligibles.

ARTICLE VIII.

Fonctions du President ou du Vice-President

1. Le Président exerce les fonctions qui lui sont attribuées en vertu d'autres dispositions du présent règlement; il doit notamment:

(a) Annoncer l'ouverture et la clôture de chaque réunion plénière du Conseil.

(b) Diriger les discussions au cours de ces sessions et assurer l'application du présent règlement; donner la parole; mettre les questions aux voix et proclamer les décisions.

(c) Rule on points of order.

(d) Subject to these Rules, have complete control over the proceedings of the session.

(e) Appoint such *ad hoc* committees of the meeting as the Council may direct.

2. The Vice-Chairman shall exercise the functions of the Chairman in the Chairman's absence or at the Chairman's request.

3. The Chairman, or Vice-Chairman when acting as Chairman, shall not vote, and another member of his Delegation shall represent his Government.

4. The Secretary shall exercise the functions of the Chairman in the event that both the Chairman and Vice-Chairman are unable to serve because of death, resignation or their ceasing to represent their Government.

SECTION IX.

Quorum and Voting Arrangements

1. Each Member Government shall have one vote.

2. The presence of Delegations representing a simple majority of the Member Governments shall constitute a quorum.

3. Except as provided in para. 6 of this Section, voting in plenary sessions shall be oral or by show of hands; except that a vote by roll call shall be taken if a special majority is required by the Agreement, or these Rules, or if a request for a vote by roll call is made by any Delegation.

4. A vote by roll call shall be conducted by calling upon Delegations in the English alphabetical order of their respective Member Governments.

5. The record of any roll call vote shall show the votes cast by each Delegation and any abstentions.

6. Voting on matters relating to individuals, except the election of officers, shall be by secret ballot.

(c) Statuer sur les motions d'ordre.

(d) Exercer, dans le cadre du présent Règlement, une pleine autorité sur les débats.

(e) Nommer les comités *ad hoc* des sessions conformément aux instructions du Conseil.

2. Le Vice-Président exerce les fonctions de Président en l'absence de ce dernier ou sur sa demande.

3. Le Président, ou le Vice-Président en l'absence du Président, n'ont pas le droit de vote et un autre membre de leur délégation représente leur gouvernement.

4. Le Secrétaire exerce les fonctions du Président dans le cas où celui-ci et le Vice-Président seraient tous les deux incapables de remplir leur charge, soit pour cause de décès ou de démission, soit parce qu'ils auront cessé de représenter leur gouvernement.

ARTICLE IX.

Quorum et vote

1. Chaque Etat Membre n'aura droit qu'à une voix.

2. Le quorum est constitué par la majorité absolue des Etats Membres représentée à la séance.

3. Sauf le cas prévu au sixième alinéa de la présente section, le vote au cours d'une séance plénière se fait oralement ou à main levée; le vote par appel nominal est de rigueur quand l'Accord ou le Règlement exige une majorité spéciale ou quand une délégation le demande.

4. L'appel nominal des délégués se fait dans l'ordre alphabétique anglais.

5. Le vote de chaque délégué participant à un vote par appel nominal ainsi que les abstentions, figurent dans le proces-verbal de la séance.

6. Les votes sur des propositions ayant trait à des individus ont lieu au scrutin secret, sauf quand il s'agit de l'élection des membres du Bureau.

7. When no nominee for an office obtains on the first ballot a majority of the votes cast, there shall be taken a second ballot confined to the two candidates obtaining the largest number of votes. If, on the second ballot, the votes are equally divided, the Chairman shall decide between the candidates by drawing lots.

8. If the Council is equally divided when a vote is taken on a question other than an election, a second vote shall be taken at the next session of the current meeting. If the Council is then again equally divided, the proposal shall be regarded as rejected.

SECTION X.

Committees

1. The Executive Committee shall consist of the Chairman, the Vice-Chairman and the Secretary. The Chairman shall be the Chairman of the executive Committee. The Executive Committee shall:

(a) Meet at least once a year between regular meetings.

(b) In addition to the duties prescribed elsewhere under these Rules, direct the conduct of the business and affairs of the Council between its meetings, except that issues of policy, unless previously decided by the Council, shall be formulated by the Executive Committee as a motion and referred to the Member Governments. Upon receipt by the Secretary of affirmative replies from a majority of the Member Governments, the motion shall be considered adopted.

(c) Prepare estimates of expenses for the next succeeding year for presentation to the Council for submission to the Organization, in accordance with the provisions of Article VI (2) of the Agreement.

(d) Co-ordinate the work of the technical committees.

(e) Function as an editorial and publications committee.

2. There shall be two technical committees (1) Hydrology and Biology, and (2) Technology,

7. Lorsqu'un candidat à un poste n'obtient pas au premier tour de scrutin la majorité des membres présents et votant, il est procédé à un second tour, mais le vote ne porte plus que sur les deux candidats ayant obtenu le plus grand nombre de voix. Si les deux candidats recueillent le même nombre de voix à ce second tour, le Président décide entre les candidats par tirage au sort.

8. En cas de partage égal des voix lors d'un vote ne portant pas sur des élections, il est procédé à un deuxième vote au cours de la séance suivante de la même session. S'il y a encore égalité, la proposition est considérée comme rejetée.

ARTICLE X.

Comites

1. Le Comité exécutif se compose du Président, du Vice-Président et du Secrétaire. Le Président du Conseil est le Président du Comité exécutif.

(a) Le Comité exécutif se réunit au moins uu fois par an dans l'intervalle des sessions.

(b) Outre les fonctions décrites dans une autre partie du Règlement, il dirige les affaires du Conseil dans l'intervalle de ses sessions; toutefois, les décisions du Comité en matière de politique, à moins qu'elles ne soient l'application de celles déjà prises par le Conseil, n'ont pas un caractère définitif et sont soumises aux Etats Membres. Si la majorité de ceux-ci se prononce en faveur des propositions du Comité et en donne connaissance au Secrétaire, ces dernières sont considérées comme adoptées.

(c) Il fait l'estimation des dépenses pour l'exercice suivant en vue de la soumettre au Conseil et ultérieurement ā l'Organisation, conformément à l'Article VI (2) de l'Accord.

(d) Il coordonne le travail des comités techniques.

(e) Il joue le rôle d'un comité d'édition et de publication.

2. Il y a deux comités techniques (1) d'Hydrologie et de Biologie, (2) de Technologie,

and each Member Government shall be entitled to membership thereon. The terms of reference of these technical committees shall be determined by the Council and shall always be published along with these Rules.

(a) At each regular meeting the Chairman shall poll the Delegations to determine if they desire membership on the technical committees for the ensuing year. Each Delegation shall indicate the person or persons it desires to serve on such committees.

(b) The technical committees shall select a chairman and a rapporteur from among their members, who shall serve for the ensuing year.

(c) The technical committees shall report to the Council through the Executive Committee at each regular meeting, and at special meetings subject to Section IV (4) of these Rules.

(d) The technical committees may establish from time to time, such *ad hoc* subcommittees as may be necessary to comply effectively with their terms of reference or to perform any special functions in pursuance thereof.

SECTION XI.

Budget and Finance

1. Except as otherwise provided in these Rules, the financial regulations of the Organization, as implemented by the administrative manual and memoranda and the procedures based thereon, shall apply to the Council.

2. A proposed budget of the Council for the next succeeding financial year consisting of proposed expenses of the Secretariat, including publications and communications, and of the proposed travelling expenses of the Chairman and Vice-Chairman, when engaged in the work of the Council between its meetings, shall after approval by the Council, be submitted to the Director-General for consideration in the preparation of the general budget estimates of the organisation.

3. When adopted by the Conference in its annual sessions as part of the general budget of the Organization, the budget of the Council shall

chaque Etat Membre a le droit de faire partie de ces comités. Les attributions de ces comités techniques sont fixées par le Conseil.

(a) A chaque session ordinaire le Président fait voter les délégations sur la question de savoir si elles désirent être membres des comités techniques durant l'année suivante. Chaque délégation indique la personne ou les personnes qu'elle voudrait voir appartenir à ces comités.

(b) Les comités techniques choisissent parmi leurs members un président et un rapporteur qui exerceront leurs fonctions l'année suivante.

(c) Les comités techniques font rapport au Conseil par l'intermédiaire du Comité exécutif, au cours de chaque session extraordinaire conformément aux dispositions de la section IV (4) du Règlement.

(d) Les comités techniques peuvent être amené á constituer des sous-comités *ad hoc*, lorsque cela est nécessaire pour leur permettre de se conformer comme il convient à leurs attributions ou de s'acquitter de toutes les fonctions spéciales qui pourraient en découler.

ARTICLE XI.

Budget et Finances

1. Sauf dispositions contraires du présent Règlement, le Règlement financier de l'Organisation, complété par le manuel et les mémorandums administratifs et les procédures qui en découlent, est applicable aux activités du Conseil.

2. Pour chaque exercice financier, le Conseil prépare un projet de budget comprenant les dépenses prévues du Secrétariat, y compris les publications et les communications ainsi que les frais de déplacement du Président et du Vice-Président quand ils ont à s'acquitter de leurs fonctions dans l'intervalle des sessions; une fois approuvé par le Conseil, ce projet de budget est soumis au Directeur général pour examen afin de lui permettre d'en tenir compte dans les prévisions budgétaires générales de l'Organisation.

3. Une fois adopté par la Conférence au cours de sa session annuelle en tant que partie intégrante du budget général de l'Organisation,

constitute the limits within which funds may be committed for purposes approved by the Conference.

4. Where two or more Member Governments decide to undertake and finance co-operative or joint projects in accordance with Article VI (4) of the Agreement, and wish the Organization to undertake the necessary financial administrative services, the Secretary shall, upon their request, assist them in working out the details with the Organization.

SECTION XII.

Participation by Observers

1. Invitations to the meetings of the Council shall be sent to those public international organizations having relationship with the Organization which provide for reciprocal representation and to those international non-Governmental organizations entitled by their agreements with the Organization to be represented by observers.

2. Invitations to be represented by observers shall also be sent to such other international organizations and to such non-member Governments which are members of the Organization, as the Executive Committee directs.

3. On an affirmative vote of three-fourths of all the Member Governments, invitations to be represented by observers shall be sent to non-member Governments which are not members of the Organization.

4. Unless the Council expressly determines otherwise, such observers may attend the plenary meetings of the Council and may participate in the discussions. Observers may also attend and participate in any technical committee sessions except executive sessions.

SECTION XIII.

Record of Proceedings

1. Summary records shall be made of each plenary session and each committee session, and shall be distributed as soon as possible to the participants.

2. As soon as possible after the end of each meeting of the Council, copies of all summary records and reports, and copies of all resolutions,

le budget du Conseil constitute la limite dans laquelle des fonds peuvent être engagés à des fins approuvées par la Conférence.

4. Quand deux Etats Membres au minimum décident d'entreprendre et de financer des projets, en commun, conformément à l'Article VI (4) de l'Accord, et désirent s'assurer sur le plan administratif le concours financier de l'Organisation, le Secrétaire s'efforce, s'ils lui en font la demande, de leur faciliter la mise au point de ces projets de concert avec l'Organisation.

ARTICLE XII.

Participation des observateurs

1. Des invitations aux sessions du Conseil sont adressées aux organisations publiques internationales qui ont avec l'Organisation des rapports prévoyant une représentation réciproque, et aux organisations internationales non-gouvernementales que leurs accords avec l'Organisation autorisent à se faire représenter par des observateurs.

2. Des invitations à se faire représenter par des observateurs sont également adressées aux autres organisations internationales et Etats non membres qui font partie de l'Organisation, conformément aux instructions du Comité exécutif.

3. Sur vote affirmatif des trois quarts des Etats Membres, les Etats non membres qui ne sont pas non plus membres de l'Organisation sont invités à se faire représenter par des observateurs.

4. A moins que le Conseil n'en décide autrement—et cela d'une facon formelle—les observateurs peuvent assister aux réunions plénières du Conseil et participer aux discussions. Les observateurs peuvent également assister et participer aux sessions des comités techniques à l'exception des sessions ayant lieu à huis clos.

ARTICLE XIII.

Comptes rendus des debats

1. Des comptes rendus analytiques sont rédigés pour chaque réunion plénière et chaque session des comités ils sont distribués dans le plus bref délai aux membre des délégations.

2. Aussitôt que possible apprès la clôture de chaque réunion du Conseil, des copies de tous les procès-verbaux et rapports, y compris des

recommendations and other formal decisions adopted by the Council shall be transmitted by the Secretary to the Member Governments and Observer Governments and Organizations.

3. A summary shall be prepared of the proceedings of each meeting of the Council and shall be published, together with such reports of committees, technical papers and other documents as the Executive Committee may consider practicable.

SECTION XIV.

Recommendations to Member Governments

1. The Council may make recommendations for action by Member Governments on any matters pertaining to the functions described in Article III of the Agreement.

2. The Secretary shall receive on behalf of the Council the replies of the Member Governments in respect of such recommendations and shall prepare a summary and an analysis of such communications for presentation at the next meeting.

SECTION XV.

Amendments to the Agreement

1. Proposals for the amendment of the Agreement as provided by Article VII of the Agreement may be made by any Member Government in a communication addressed to the Secretary. The Secretary shall transmit to all Member Governments and to the Director-General a copy of such proposals for amendment immediately upon their receipt.

2. No action on a proposal for the amendment of the Agreement shall be taken by the Council at any meeting unless it has been included in the provisional agenda of the meeting.

3. In accordance with Article VII of the Agreement, proposals for amendment of the Agreement which extend the functions of the Council or extend the powers of the Council to incur expenses shall, if adopted by the Council, be transmitted to the Director-General for the approval of the Conference and of the Director-General respectively.

copies de toutes résolutions, recommandations et autres décisions adoptées par le Conseil, sont transmises par le Secrétaire aux Etats Membres, aux Etats et aux organisations représentés par des observateurs.

3. Un résumé des débats de chaque réunion du Conseil est publié conjointement avec les comités, les mémoires techniques et autres documents que le Comité exécutif estime opportun de faire paraître.

ARTICLE XIV.

Recommendations aux Etats Membres

1. Le Conseil peut adresser des recommandations aux Etats Membres sur les mésures à l'égard de toute question relative aux fonctions mentionnees dan l'Article III de l'Accord.

2. Le Secrétaire recoit au lieu et place du Conseil les réponses des Etats Membres aux dites recommandations et fait le résumé et l'analyse de ces communications en vue de leur présentation à la session suivante.

ARTICLE XV.

Amendements a l'Accord

1. Les propositions d'amendement à l'Accord par application de l'Article VII du dit Accord peuvent être présentées par un Etat Membre dans une communication adressée au Secrétaire. Ce dernier adresse dès leur réception, à tous les Etats Membres et au Directeur général, une copie de ces propositions.

2. Le Conseil ne prend en séance aucune décision à l'égard d'une proposition d'amendement, à moins que cette dernière n'ait été à l'ordre du jour provisoire de la réunion.

3. Conformément à l'Article VII de l'Accord, les propositions d'amendement à l'Accord adoptées par le Conseil et destinées à élargir ses fonctions ou à accroître ses pouvoirs en ce qui concerne l'engagement des dépenses, sont transmises au Directeur général pour approbation par la Conference et par le Directeur général respectivement.

SECTION XVI.

Suspension and Amendment of Rules

1. Subject to the provisions of the Agreement, any of the foregoing sections other than IV, X (2), XI and XV may be suspended on the motion of any Delegation by a two-thirds majority of the votes or at any plenary session of the Council, provided that announcement is made at a plenary session and copies of the proposal for suspension have been distributed to the Delegations not less than 48 hours before the session at which action is to be taken.

2. Amendments of, or additions to, these Rules may be adopted on the motion of any Delegation by a two-thirds majority of the votes cast at any plenary session of the Council, provided an announcement is made at a plenary session and copies of the proposal for the amendment or addition have been distributed to Delegations not less than 24 hours before the session at which action is to be taken.

3. The Executive Committee may propose amendments and additions to these Rules, and any such proposols may be considered at the next meeting of the Council.

4. Any amendment to Section XV, which may be adopted in accordance with the provisions of para. 2 of this Section, shall not become effective until the next meeting of the Council.

SECTION XVII.

Official Languages

The official languages of the Council shall be English and French. Delegations may use either language at meetings; reports, manuscripts and communications may be written in either language; publication of reports and manuscripts shall be in the language in which they are submitted and, when required by the Council or the Executive Committee, abstracts in translation may be published.

ARTICLES XVI.

Suspensions et amendements relatifs aux Articles du Reglement

1. Sous réserve des dispositions de l'Accord, tous les Articles du Règlement qui précèdent à l'exception des Articles IV, X (2), XI et XV peuvent être provisoirement suspendus par un vote à la majorité des deux tiers des voix exprimées au cours d'une séance plénière du Conseil, à condition que notification en ait étè donnée au cours d'une session plénière et que des copies de la proposition de suspension aient été distribuées aux délégations 48 heures au moins avant la session au cours de laquelle une décision doit être prise à ce sujet.

2. Les amendements ou les additifs au Règlement peuvent être adoptés à la majorité des deux tiers des votes émis en session plénière du Conseil, à condition qu'il en soit donné préavis au cours d'une session plénierè et que des copies de la proposition d'amendement aient été distribuées aux délégations au moins 24 heures avant la session au cours de laquelle une décision doit être prise à cet égard.

3. Le Comité exécutif peut proposer des amendements et des additifs au présent Règlement, et ces propositions peuvent faire l'objet d'un examen au cours de la prochaine réunion du Conseil.

4. Tout amendement à l'Article XV qui pourrait être adopté conformément aux dispositions du deuxième alinéa de cet article n'entrera en vigueur qu'au cours de la session suivante du Conseil.

ARTICLE XVII.

Langues officielles

Les langues officielles du Conseil sont l'anglais et le francais. Les délégations peuvent se servir de l'une ou l'autre de ces langues au cours des réunions; les rapports, les documents et les communications peuvent être rédigés également dans l'une ou l'autre langue. Les rapports et les manuscrits sont publiés dans la langue dans laquelle ils auront été soumis et, sur demande du Conseil ou du Comité exécutif, il peut en être publié des résumés en traduction.

TERMS OF REFERENCE OF THE TECHNICAL COMMITTEES

Adopted During Session Ten (see above page 14).

ATTRIBUTIONS DES COMITES TECHNIQUE

Adopte Pendant la lere Session (soi Supra page 14).

The Council may refer to the Technical Committee specific problems, and the Committees shall study and report there in with recommendations, for Council section. The Council may refer to:—

(a) The Committee for Hydrology and Biology specific problems of the development and proper utilisation of the fishery resources, and dealing with (1) the aquatic biosphere and the physical and chemical phenomena required for proper understanding thereof; (2) identification and description of the natural units of the stocks of aquatic organisms; (3) migratory, feeding and reproductive habits; (4) rates and causes of recruitment, growth and mortality; (5) the measurement and analysis of population levels and their fluctuations and the effect of fishing operations thereon; and (6) increasing fish-cultural production through the development and application of biological techniques.

(b) The Committee on Technology specific problems of the development and proper utilization of the fisheries, and dealing with (1) the capture, preservation, processing, distribution, marketing and consumption of fish and fishery products; (2) fish-pond engineering and management, and, with reference to the foregoing; (3) equipment, facilities and techniques; (4) statistics; and (5) economic factors such as financing and manpower.

Le Conseil peut renvoyer aux comités techniques des problèmes particuliers, et les comités les étudieront et presenteront sur ces problèmes son rapport accompagné des recommendations pour décisions du conseil.

Le conseil peut renvoyer à

(a) la comité d'hydrologie et de biologie, les problèmes particulier au développement et à l'utilisation rationelle des resources dc pêches, et concernant (1) la biosphere aquatique et les phenomènes physiques et chimiques nécessaires d'une comprehension convenable de celle-ci; (2) l'identification et la description des unités naturelles dans les stocks d'organismes aquatiques; (3) les habitudes d'alimentation migratoires et les moeurs de reproduction; (4) les taux et les causes de recrutement, de développement et de mortalité; (5) la mensuration et l'analyse des niveaux de population et de leur fluctuation et l'effet sur ceux-ci des opérations de pêche—(6) l'accroissement de le production des produits de culture par le développement et l'application des techniques biologiques.

(b) la comité de technologie, les problèmes specifiques de developpement et de l'utilisation rationelle des pêcheries et concernant (1) la capture, la conservation, le traitement, la distribution, la vente au détail et la consommation du poisson et des produits de pêcherie; (2) les travaux d'installation des viviers et leur exploitation et, au sujet de ce qui précède; (3) outillage, facilités et technique; (4) statistiques; (5) facteurs économiques tel que financement et main d'oeuvre.

LIST OF DELEGATES AND OBSERVERS

Official Delegations

Australia.	Dr. H. Thompson, Delegate.	Chief, Division of Fisheres, CSIR, Cronulla, N.S.W.
	F. T. Homer, Esq., Alternate.	Acting Official Secretary, Australian Commissioner's Office, Singapore.
Ceylon.	Dr. C. Amirthalingam, Delegate.	Director of Fisheries, Ceylon.
China.	Dr. Wu Paak Shing, Delegate.	Consul-General of the Republic China, Singapore.
France.	Mon. J. Lemasson, Delegate.	Chief, Services des Peches et Chasses de l'Indo-Chine, Pnom Penh.
	Mon. J. Durand, Alternate.	Assistant Institut Oceanographique de l'Indo-Chine, Nhatrang.
India.	Dr. Baini Prashad, Delegate.	Fisheries Development Adviser, Min. of Agriculture, New Delhi.
	Dr. N. K. Panikkar, Alternate.	General Physiologist Central Marine Fisheries Research Stn., Madras.
Netherlands.	Dr. J. K. de Jong, Delegate.	Head of Sea Fisheries, Batavia.
	Dr. J. D. F. Hardenberg, Alternate.	Head of the Laboratory for the Investigation of the Sea, Batavia.
	W. H. Schuster, Esq.	Inland Fisheries, c/o Laboratory for the Investigation of the Sea, Batavia.
	Cdr. H. W. R. Krauss.	Hydrographer, Dept. of Navigation Batavia.
	P. W. Lokollo, Esq..	Fisheries Adviser for East Indonesia.
Philippines.	Claro Martin, Esq., Delegate.	Chief, Division of Fisheries Technology, Bureau of Fisheries Manila.
United Kingdom.	Dr. W. M. Clyde, Delegate.	Director, Economic Activities, Office of Com. Gen. for U.K. in S.E. Asia.
	Dr. H. W. Jack, Alternate.	Agriculture Adviser to the Commissioner General.
	T. W. Burdon, Esq..	Acting Director of Fisheries. } Fisheries Dept. The Federation of Malaya and The Colony of Singapore.
	Tham Ah Kow, Esq..	Research Officer.
	Soong Min Kong, Esq..	Research Officer.
	Chia Chye Khoon, Esq..	Ag. Fisheries Officer.
	E. Banks, Esq..	Fishery Survey Officer, Sarawak.
	J. A. Tubb, Esq..	Director of Fisheries, Sandakan, North Borneo.
	E. H. Weigall, Esq..	Fisheries Officer, Brunei.

United Kingdom (continued)	J. Cater, Esq..	Acting Director of Fisheries, Fisheries Dept. G.P.O. Building, Hong Kong.
	S. Y. Lin, Esq..	Asst. Officer-in-Charge Fisheries Dept. Hong Kong.
	M. W. F. Tweedie, Esq..	Director, Raffles Museum, Singapore.
	Dr. C. A. Gibson-Hill.	Assistant Curator, Raffles Museum, Singapore.
U. S. A.	Oscar E. Sette, Esq., Delegate.	Director, Pacific Oceanic Fisheries Investigation. Fish & Wildlife Service Dept. of the Interior, San Francisco, California.
	Dr. Wm. E. S. Flory, Alternate.	Deputy Special Assistant to the Under Secretary, Dept. of State. Washington, 25, D.C.
	Dr. Hilary J. Deason.	Chief, Office of Foreign Activities, U.S. Fish & Wildlife Services—Dept. of Interior, Washington, 25, D.C.
	Chas. Butler, Esq..	Chief, Technological Activities Pacific Oceanic Fisheries Investigations Fish and Wildlife Service, Dept. of the Interior Honolulu, Hawaii.
	Herbert Warfel, Esq..	Biologist-in-Charge, Biological & Oceanographic Investigations, Philippines Fishery Programme, Fish & Wildlife Service, Manila.

Official Observers

Korea.	Chyung Moon Gi, Esq..	Economic Planner, Planning Board, Republic of Korea—Scoul.
	Whang Sung Soo, Esq..	Chief of Information Bureau, Ministry of Foreign Affairs, Scoul.
S. C. A. P.	W. C. Herrington, Esq..	Natural Resources Section (Fish. Div.) G.H.Q.—SCAP Tokyo.
South Pacific Commission.	Dr. Wm. E. S. Flory.	U.S.A.
	Dr. H. Thompson.	Australia.
	Mon. J. Lemasson.	France.
	Dr. J. D. F. Hardenberg.	Netherlands.
U. N. E. S. C. O. Delhi	Dr. A. Wolsky.	Principal Field Scientific Officer, for South Asia.
Manila.	W. J. Ellis, Esq..	Field Scientific Officer for East Asia.

Unofficial Observers

Commissioner-General's Office, Singapore.	R. G. Stone, Esq..	Secretary, Economic Department.
Federation of Malaya.	Anker Rentze, Esq..	Development Officer, Kota Bahru, Kelantan.
	Che' Jaidin b. Alang Musa.	c/o District Hospital, Alor Gajah, Malacca.

Medical College.	Dr. D. W. G. Faris.	Principal.
	Prof. J. W. H. Lugg.	Prof. of Biochemistry.
	Dr. J. W. Black.	Supernumerary Tutor of Physiology.
	Dr. N. K. Sen.	Act. Professor of Bacteriology.
	Dr. J. H. Strahan.	Prof. of Social Medicine & Hygiene.
	Dr. Lim Kok Ann.	Tutor in Bacteriology.
	R. Mannikam, Esq..	Senior Laboratory Assistant, Special Grade.
	Lim Boon Par, Esq..	Final Year Medical Student.
Ministry of Food.	A. R. Pratt, Esq..	Ministry of Food Representative in S. East Asia.
Raffles College, Singapore.	Dr. G. V. Allen.	Principal Designate of the University of Malaya.
	Prof. W. E. Dyer.	Professor of History & Pricipal of Raffles College.
	Prof. R. A. Robinson.	Professor of Chemistry.
	Dr. E. H. G. Dobby.	Professor of Geography.
	Prof. Lim Tay Boh.	Ag. Professor of Economics.
	Kiang Ai Kim, Esq..	Lecturer in Chemistry.
	Mrs. Tong.	Assist. Lecturer in Chemistry.
	K. Bieda, Esq. Ungku Aziz b. A. Hamid	Economics Department.
	Jacob Low, Esq. Oh Sui Hong, Esq.	Students (Final Year).
Raffles Museum, Singapore.	H. D. Collins, Esq..	Curator, Raffles Museum, Singapore.

Secretariat (F.A.O.)

Washington.	Norris, E. Dodd, Esq..	Director-General.
	J. Orr, Esq..	Assistant Secretary General of the International Emergency Food Committee.
	M. Veillet-Lavallee, Esq..	Special Assistant to the Director-General.
	Dr. J. L. Kask.	Fisheries Division.
Bangkok.	Charles L. Coltman, Esq..	Information Officer.
Singapore.	Dr. G. L. Kesteven.	Regional Representative (Fisheries).

The major river systems of China. See paper No. 1 in Section 3, by S. Y. Lin.

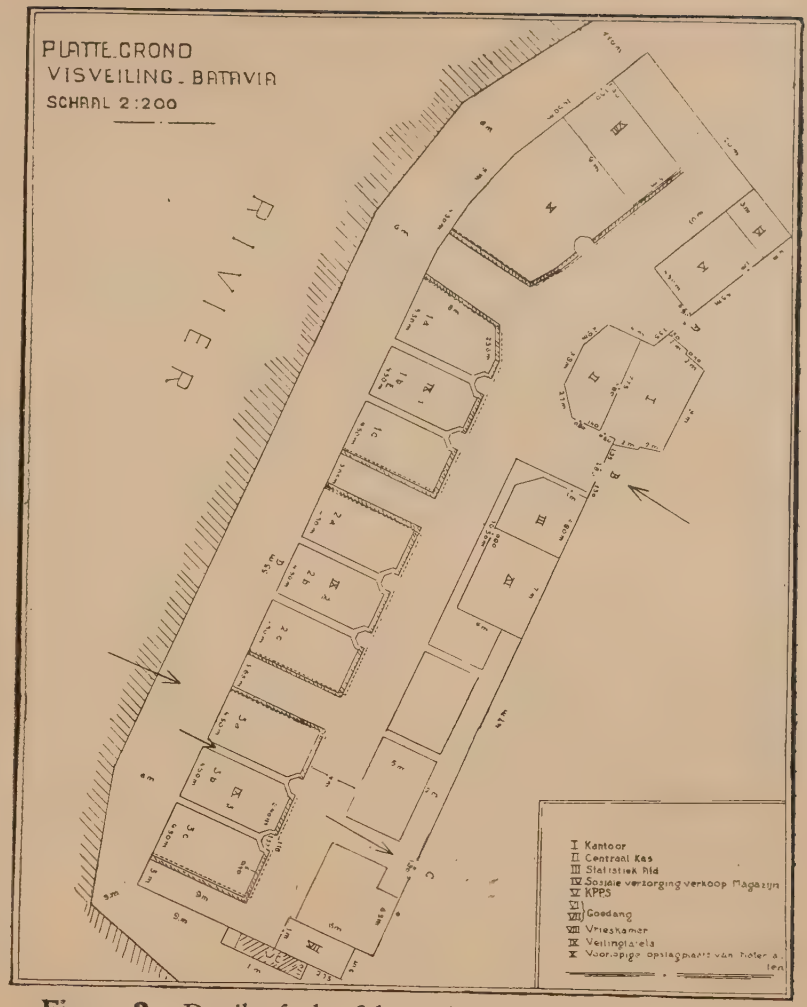

Figure 2. Detail of the fish market at Batavia. See paper No. 6 in Section 2.

Section 2

WORKING PAPERS

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WORKING PAPERS ISSUED FOR AND DURING THE CONFERENCE.

IPFC/C49/1.	Agenda.
IPFC/C49/2.	Agenda Item 7—Draft Rules Procedure (issued from Washington). Also re-issued as IPFC/C49/2 revised. Replaced by adopted rules, see pp. 22-32.
*IPFC/C49/3.	Communication from the International Commission on Zoological Nomenclature.
IPFC/C49/4.	Agenda. Item 6—Organization of the Council (issued from Washington).
*IPFC/C49/5.	Programme of Statistical Work.
IPFC/C49/6.	F.A.O. Journey's Fund.
IPFC/C49/7.	Report on the items relevant to fisheries in the Programme of the Seventh Pacific Science Congress, New Zealand, Feb. 2—22nd, 1949.
*IPFC/C49/8.	Report of the Fisheries Technology Committee.
*IPFC/C49/9.	Proposal for Establishment of a Panel of Experts.' Buitenzorg Meeting, Resolution VII.
IPFC/C49/10.	Appointment of Technical Committes.
*IPFC/C49/11.	"A programme of Socio-Economic Research for the Fisheries of South East Asia".
IPFC/C49/12.	Institutions, Projects, Vessels and Personnel.
IPFC/C49/13.	Report of the Committee for Taxonomy—Chairman, Dr. S. L. Hora.
IPFC/C49/14.	Baguio Agreement Acceptances.
IPFC/C49/15.	Report on the Survey of existing Fishery Programmes in and related to the Indo-Pacific Area and on the collection of special information.
*IPFC/C49/16.	Technical Committee II. (Re-issued as IPFC/C49/16 revised).
*IPFC/C49/17.	Fish Marketing in Batavia.
IPFC/C49/18.	Suggested Terms of Reference for the Technical Committees.
IPFC/C49/19.	Secretary's Report on the Proposed Rules of Procedure.
*IPFC/C49/20.	Recommendations of Technical Committee I.
*IPFC/C49/21.	Recommendations of Technical Committee II.
IPFC/C49/22.	Budget.
Un-numbered.	Rules of Procedure as adopted on Thursday 31st March 1949.

Only papers marked with asterisk are published in this report.

1

COMMUNICATION FROM THE INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE

Personal address of the Sec'y:
28 Park Village East,
Regent's Park,
London, N.W. 1, ENGLAND.
9 January 1949.

Dear Sir,

Indo-Pacific Fisheries Council; Invitation to the International Commission on Zoological Nomenclature to be represented by an Observer at the meeting to be held at Singapore in March, 1949.

1. With reference to the recent letter addressed to Dr. James L. Peters (Museum of Comparative Zoology at Harvard College, Cambridge, Mass.), President of the International Commission on Zoological Nomenclature, on the above subject, I write to say that the International Commission on Zoological Nomenclature greatly appreciate the invitation extended to them by you that they should be represented by an Observer at the meeting of the Indo-Pacific Fisheries Council to be held in Singapore in March next, but that they regret that, so far as they can see at present, it will not be possible for them to be represented on this occasion.

2. There is, however, a proposal which the International Commission desire should be submitted to the Council, the adoption of which would, the Commission are convinced, materially assist research officers working on fisheries problems in the Indo-Pacific region. At the request of the Commission, therefore, I have the pleasure to transmit the accompanying short memorandum which they will be grateful if you would be so good as to cause to be laid before the Council when it meets.

3. No one single factor has caused more confusion in scientific literature and consequently in the work of research officers in the applied fields of biology than the confusion caused by the multiplicity of scientific names applied to particular species and the constant changes in the names so used, made not on taxonomic grounds but solely for nomenclatorial reasons. The International Commission, as the body charged with the duty of co-ordinating all matters in connection with zoological nomenclature, realises that the confusion resulting from constant changes in the names of species of economic importance constitutes a serious impediment to the orderly development of research and they accordingly strive by all means in their power to promote greater stability in zoological nomenclature. One of the principal instruments which, with the approval of the International Congress of Zoology, has been developed by the International Commission for this purpose is represented by two "Official Lists" one for the names of genera, the other for the names of species, which the Commission have established, for once a name has been placed on either of these "Official Lists" it is assured of stability by being immune from disturbance on purely technical nomenclatorial grounds.

4. The proposal now submitted is designed to secure stability in the scientific names of fish and other marine animals of economic importance in the Indo-Pacific Region by making arrangements for the names of those species to be placed on the "Official Lists" referred to above. A considerable part of the necessary work, including the whole of the cost of publication can be defrayed by the International Commission from its own resources, but a small grant would be required to enable the Commission to engage, on a fee basis, a specialist or specialists to examine the scientific literature involved and to prepare list of the names to be added to the "Official Lists".

5. The International Commission believe that great material advantages would be secured for fisheries research officers in the area by the stabilisation of scientific nomenclature in the manner proposed and they sincerely hope both that their proposal for a co-operative attack on this problem will meet with the approval of the Indo-Pacific Fisheries Council and that either the Council or the Food and Agriculture Organisation will ensure that the necessary small financial contribution towards the cost of this scheme is made available.

Yours faithfully,
(Signed) Francis Hemming.
Secretary to the International Commission
on Zoological Nomenclature.

The Director-General,
Food and Agricultural Organisation of the
United Nations,
2000 Massachusetts Avenue, N.W.,
Washington 6,
D.C. U.S.A.

THE IMPORTANCE TO FISHERIES DEVELOPMENTS OF A STABLE SYSTEM OF ZOOLOGICAL NOMENCLATURE

1. The International Commission on Zoological Nomenclature greatly appreciate the honour of being invited to be represented by an observer at the meeting of the Indo-Pacific Fisheries Council opening at Singapore on 24th March 1949. As the central international body charged by the International Congress of Zoology with responsibility for all matters affecting zoological nomenclature, the Commission is keenly conscious of the fact that workers in the applied fields of biology, such as fisheries research workers, are directly concerned to secure a stable scientific nomenclature for the fishes and other marine species with which their work is concerned. The Commission recognise that formerly insufficient attention was paid by systematic zoologists to the importance of this consideration and too often the names of species of economic importance were changed for technical nomenclatorial reasons of no interest to workers in the applied fields and that such changes caused much inconvenience to, and in some cases confusion in the work of, this important group of workers.

2. The International Commission consider it one of their most important duties to do everything possible, either directly or with the assistance of interested bodies, to promote stability in zoological nomenclature, particularly as regards the names of genera and species of economic importance. In this matter, the Commission have received enthusiastic support from the International Congress of Zoology, the body which acts as the mouthpiece of zoologists of all countries and from which the Commission derive their authority. With the approval and authority of the Congress, the Commission have established two "Official Lists" of names, the first for the names of genera, the second for the names of species, designed to secure stability for the names of the genera and species standardised in this way. Once the name of a genus or species has been placed upon the "Official List" concerned, that name may not be discarded on nomenclatorial grounds in favour of another name or used in any sense other than that specified in the List without the prior approval of the Commission, an approval not given except in the most exceptional circumstances. The placing of names on these "Official Lists" thus guarantees a high degree of stability for the names of the genera and species concerned.

3. In compiling proposals for the addition of names to these "Official Lists", the Commission needs, first the active co-operation of specialists in the systematics of the groups concerned, second the support of organisations and institutions, either national or (preferably) international, in order to ensure that the names of all species of importance in the economics or other applied fields of biology are stabilised in this way.

4. In their policy of stabilising the names of genera and species of economic or other special importance, the Commission are assured of the support of every responsible zoologist and it is only lack of the necessary funds which has so far prevented the Commission from making as rapid an advance in this field as they would have desired. The Commission enjoy an annual grant from UNESCO for the furtherance of their work, but this grant, though of the greatest value in many ways, is not sufficient to enable the Commission to develop the "Official Lists" in the only way by which this can effectively be done, namely by commissioning specialists in the systematic field, on a fee basis, to undertake the laborious and highly technical task involved in the study of a complex scientific literature necessary before names can properly be admitted to the "Official Lists".

5. The International Commission accordingly desire to submit for the consideration of the Indo-Pacific Fisheries Council a proposal that the Council should arrange for the provision of a limited sum to enable the Commission to invite a leading systematic worker or leading systematic workers possessing a special knowledge of, and interest in, fisheries problems, to prepare proposals for the addition to the "Official Lists" of the names of genera and species of fish and other marine animals of special importance to the fisheries of the Indo-Pacific Region.

6. The International Commission estimate that, if it were possible to provide a sum of five-hundred pounds (£500) for the payment of specialists for the fore-going purpose, it should be possible within a short time to make substantial progress in the stabilisation of the scientific names of genera and species of fishes and other marine animals of importance to the Indo-Pacific fisheries. For their part, the Commission would be prepared both to undertake the editorial work involved in preparing for publication the proposals submitted to them by the specialists concerned. The Commission would be prepared also to defray the whole cost of printing and publishing the consequent additions to the two "Official Lists".

7. It is the sincere hope of the International Commission that the foregoing proposals will commend themselves to the Indo-Pacific Fisheries Council and that the Council will be able to secure the provision of the small sum necessary to secure, on the co-operative basis suggested, the stabilisation of the names of the fishes and other marine animals which are of importance to the work of the Council and, through it, to the Governments of the countries and territories associated with its work and thus at a small cost to make an important contribution to the orderly development of fisheries research in the Indo-Pacific Region.

Signed on behalf of the International
Commission on Zoological Nomenclature
FRANCIS HEMMING
Secretary to the Commission

Secretariat of the Commission:
28 Park Village East,
Regent's Park, LONDON, N.W.1
7th January 1949.

2

PROGRAMME OF STATISTICAL WORK

Annexure to the Report of Sub-Committee on Statistics Appointed by the Fisheries Conference New Delhi, September 27th to 30th, 1948. Modified and added to in accordance with recommendations of the Informal Meeting of British Fishery Officers, Singapore, October, 1948.

1. Objects of Statistical Collection.
2. Definitions and List of Factors.
3. Methods of Collection
   3.1 Programmes of Collection.
   3.2 Points of Collection.
   3.3 Collecting Agencies or Personnel.
   3.4 Forms.
4. Compilation, analysis and interpretation.

1. OBJECTS OF STATISTICAL COLLECTION

Statistics are collected:—

A. In connection with administrative programmes, to furnish basic data for an understanding of the industry, and for the formulation of all types of administrative action in respect of conservational or other management of the industry and socio-economic work among the fishermen.

B. In connection with socio-economic research, where statistics relating to the social and economic factors of the industry constitute the raw material for study.

C. In biological research programmes, where sible to an effective programme of research; the statistics relating to factors of production are necessary for a proper understanding of the phenomena presented in the statistics of production.

In general it may be stated that statistics of the industry are the essential data upon which Governmental action, of administrative, developmental and research nature, should be based.

It must be pointed out here that some statistics relate to the industry—to the factors of production and distribution, whilst others relate to the resource; the separate uses of these two types must be recognised. Further, it should be observed that, because of the concealed nature of the resources, in most cases, as distinguished from agricultural resources, the availability of statistics is of greater importance in fisheries work than in agriculture, and therefore greater importance attaches to the proper planning of the collection and use of such statistics.

2. DEFINITIONS AND LIST OF FACTORS

The collection of statistics will be made in respect of areas (districts, villages, etc.) or of unit fisheries (sardine fishery, hilsa fishery, lake fisheries, etc.). A natural area or method unit should be sought.

AREAS. The area in respect of which statistics will be collected for unit fisheries may be defined in simple geographic terms or on the basis of the distribution of selected critical ecological factors, such as salinity or temperature; it would be desirable that such boundaries should be proposed by the fishery workers of each province or state and be examined by an expert committee to ensure uniformity and effective integration of the collection systems.

UNIT FISHERY. The unit fishery is the set of operations distinguished as to area, time, method or species.

Statistics will be collected within the following framework —

A. Factors (These statistics will consist of number of units, and their capacity, etc.).

a. Production

i. Area of Cultivation or Exploitation.

Area of Cultivation. This must be some mean, surveyed estimate of area of water under cultivation; it might be found necessary to consider some specification of depth in this connection

Area of Exploitation. It will be desirable to form some general estimate of the areas of marine, brackish and fresh waters subject to exploitation.

ii. Fry Collection.

Clear specification of the stage enumerated will be essential; that is, ova of various stages, fry, fingerlings must be indicated and an attempt made to equate them on the basis of allowing for mortality; that is to say, a certain number of ova collected will not be equivalent to the number of fry liberated.

iii. Men Engaged.
A classification of this item by importance of fishing activity, that is, by the number partly or fully engaged in fishing, according to the type of work on which engaged etc. For some studies it will be necessary to collect data on nationality, age, educational status and so forth.

iv. Equipment (boats, nets, lines, traps, other means of capture).
Boats. There must be specification of type of vessel, length, breadth and draft, motive power, and where powered, the type and strength of equipment, and the character of the standing fishing gear; nature and character of inboard storage must also be shown.
Nets. These will be specified as to type, size and mesh.
Lines. These will be specified as to type and number of hooks, and where long lines are used, length of main line and of snoods.
Traps. Specified as to type.

b. Distribution

v. Transport Units.
Specified according to whether water, land or air transport; length of haulage and frequency of trip to be noted; technical details of transport unit, with respect to motive power, equipment for holding fish in good condition.

vi. Storage Units.
Specified as to type of storage with technical detail of capacity of plant, refrigeration method and so forth.

vii. Processing Units (curing yards, oil plants, smoke houses, etc.).
Specified as to design, capacity, technical features of equipment and method.

viii. Ice Production.

B. Volume and Movement of Supply.

These statistics will relate to:—

Distinct species of fish.

Species (*Fish names*). It is important that the true identity of fish species to which statistics refer should be established; a project to fix the scientific name corresponding to each local name usage is necessary.

They will be recorded either for (a) area of catch or (b) point of landing;

Point of landing. The first point at which fish is discharged upon land; if fish should be tranferred from a fishing vessel to a carrier vessel at sea or during operations, the point of discharge of the carrier vessel will constitute the point of landing. If fish should be collected by a carrier vessel from a landing point and taken to some other point the former will nevertheless be the point of landing for that fish.

or (c) point or area of handling or processing;

or (d) point of market discharge.

Point of market discharge. The point at which the fish is discharged from boat, train or road transport for the purpose of entering wholesale market operations; point of landing and point of market discharge may be the same for some fish.

i. Fresh Fish.

To be specified as whether in the round (fresh landed weight, before gutting, scaling or cleaning), gutted, headed and gutted, or headed, gutted and scaled.

ii. Frozen or Stored Fish.

Frozen or stored fish. To be specified as for Fresh fish.

Processed fish. To be specified as to method of processing, and a factor must be devised to enable weights of such processed fish to be expressed in weights of round fish from which the processed fish is produced.

C. Prices, Costs and Income.

i. Prices.

Prices. In many cases the fish catch changes hands many times before it reaches the consumer. The main interest will be in first wholesale price and the retail price.

First Wholesale Price. Wholesale is taken to mean "sale for re-sale." The first wholesale is the price offered to the fisherman.

Retail price. This is the price paid by the consumer.

Profit Margin. In many cases in this area there will be a number of profit margins before fish reaches the consumer. It is suggested that, in order to obtain uniform information, the profit margin should be the difference between the price offered in the first wholesale and that in the retail, i.e. the profit margin will be taken as the sum of *all* profit margins in the middlemen transactions and will correspond to the term "price spread" as sometimes used.

ii. Costs.

Production Costs. These should include cost or maintenance of all gear and equipment used in production and a charge for its depreciation. It will also include payment of interest on capital loans, and cost of fuel, labour, and food if deck hands receive food on board as part of their remuneration.

Marketing or Distribution Costs. These will include cost of collection, transport, packing, sorting and sale. In most cases it is found that the fisherman bears all, or part of, this expenditure, at the first wholesale, in the form of a percentage commission charge.

iii. Processing Costs.

For the main, these will be confined to the cost of labour, salt and ice but where canning and other methods of processing are practised, these costs will include cost and maintenance of equipment and other capital goods, labour, fuel and payment of interest on capital loans.

iv. Incomes.

In the case of the owner operative, gross money income is normally total price offered for the catch at first wholesale less commission and handling charges in marketing. Net money income is gross income less production costs as enumerated above. Real income is to be considered in terms of goods, services, supplies, amusements, savings, luxuries and so forth which the money income can purchase. In this it is bound up with price levels and the individual standard of living. It is therefore suggested that real incomes be calculated by taking into consideration average necessities according to the society or group to which the individual belongs. It will later be necessary to select price levels for a base year, preferably a pre-war one, with which to compare yearly figures. As with the owner or master of a vessel, it is necessary in the interests of the industry to find the incomes, both money and real, for the crew members. In this respect special note must be made of any shelter, food, bonus and so on that is received by crew members as labour reward in addition to any wages received.

It should be borne in mind that these statistics will from time to time be analysed and interpreted in conjunction with other data, of statistical nature, collected under other programmes. For instance, statistical data relating to economic factors outside the industry but bearing upon it, such as data on population questions and also data on meteorological elements, oceanographic factors, etc., will have to be considered. The above framework is therefore to be regarded as relating only to the industry, its components and its products.

3. METHODS OF COLLECTION

Whilst it is recognised that there is at present a minimum of staff and facilities for the collection of any statistics at all, and that finance and personnel problems will restrict the programme severely for some time to come; nevertheless it is thought desirable to set out the methods of collection in detail.

It is also recognised that there are three major difficulties which impeded the development of an accurate and comprehensive statistical system. These are:—

A. The diffuse nature of the fishing operations, with relatively few points at which supply is concentrated;

B. The fact that there is no licensing or registration, as a result of which it is difficult for administration to establish an accurate picture of the industry;

C. The low educational status of the operatives, as a result of which there can be no operatives' returns which in other countries serve as the basis of the statistical system.

It is probable that real advance in this programme will await effective action in respect of these problems.

3.1 Programmes of Collection: The basic requirement to which the programmes of collection (and of subsequent handling of the statistics) should conform is that they should relate to unit fisheries. In this way it becomes possible to identify the fish supply with a specific group of men, vessels and units of gear, and eliminates some confusion effects which otherwise tend to develop.

A further point which requires emphasis is that the programme should be planned to yield specific information for specific purposes. For this reason it is essential that the people who require the information should participate in the design of the programme and should state their requirements.

The following will exemplify the type of programme which might be undertaken.

A. *Routine Collection.*

By routine collection is meant the collection of statistics indefinitely as a more or less fixed function of fisheries administration; collection of this sort will necessarily relate in the beginning to only a proportion of the array of factors, but the system should aim to effect routine collection of all relevant statistics, in appropriate time pattern; it is probable also that the routine collection will initially relate to only a part of the industry. Routine collection of statistics may be effected by (a) complete enumeration, or (b) sample survey of a selected group of factors over a restricted sample section of the total field of survey.

B. *Intensive Investigation.*

This means the collection of statistics within restricted areas or sections of the industry, for specific periods, for part or all of the array of factors, with an intensity which would not be possible in routine collection. Such projects might relate to socio-economic, technological, biological or administrative problems.

C. *Research in Statistical Techniques.*
These are projects of a research and experimental character, undertaken to evolve suitable statistical techniques which can subsequently be adopted for purposes of routine collection or intensive investigation.

3.2 Points of Collection: It may be assumed that eventually statistics would be collected at all the significant points at which fish catch is assembled. At some remote time it might be possible to arrange for statistical record to be made at the point of catch, as is done in the more advanced fisheries of European countries, Canada and the U.S.A. However, at present a selection must be made of the strategic assembly points at which a significant proportion of the supply may be noted. These will include certain discharge and landing points, certain markets and various processing centres.

In the case of some collections, where an officer is appointed solely for this purpose, point of collection will be unspecified—that is, the collector will roam widely and collect on the beach, in the village and on the road.

Even in the interim programme, collection points should, if possible, be selected to stand in some logical relation to the whole industry to permit of extrapolation.

3.3 Collection Agencies and Personnel: The ultimate aim may be the provision of staff engaged solely on this task of collecting statistics with their efforts supplemented by part-time workers. In the initial stages, it is probably inevitable that it should prove necessary to make use only of part-time personnel. It is necessary, in this programme, to recognise the contribution which is made to this work

by other departments. Data may be drawn from revenue, customs and other departments.

3.4 Forms: The choice of forms will depend upon the programme of collection, in which must be included the facilities available. Separate forms will be required for the collection of statistics in respect of (1) factors of production, (2) factors of distribution, (3) volume of supply, and (4) prices. It will be necessary to have separate forms for inland and marine fisheries and it may prove necessary to have further distinct forms for special unit fisheries.

It will be possible for the statistical section to evolve interim standard forms on the basis of present collection procedure; at the same time standard forms satisfying the full requirements of this programme should be prepared and it should be the aim of government to evolve their collection programmes to be able to employ these forms.

It is to be noted that the standardisation of forms would be undertaken (1) to serve the purposes of standardisation of terminology etc. indicated in section 2 above, and (2) to ensure efficiency in the collection and tabulation of the data.

4. COMPILATION, ANALYSIS AND INTERPRETATION

After the primary collection of the statistics there follow the three stages of compilation, analysis and interpretation. In the compilation phase the statistics will be assembled and tabulated in accordances with the requirements stipulated by the experts. In this phase checks will be exercised as far as possible. Initially there will be little opportunity for checks but as the system develops it should be the aim to establish a fully consistent body of data. In this connection it may be remembered that the fish catch passes along channels of distribution and is progressively diverted and reduced in volume; reduction follows from wastage, from gutting, scaling, cleaning, and in the case of processing from dehydration or other modes of elimination. The degree of reduction can be measured and fairly reliable conversion factors can be produced for relating fish of one form to fish of another. The most important conversion required is back to round weight.

In the analytical stage the data will, in the case of time series, be transferred to graphs, and trends will be worked out and measured statistically. In this process seasonal and random fluctuations will be eliminated and major secular trends corresponding to significant developments in the industry and the resources will be identified. From this point an attempt will be made to establish circulations between various series in order to determine whether there is any casual relationship between their respective movements. Deeper analysis will proceed as dictated by the Specialists' requirements.

The final stage is the interpretation of the data and of the analytical results, and this is the rseponsibility of the Specialists engaged in the programme, assisted by the Statistician.

It should be clearly understood that the above programme does not include collection of biometrical data, and it should be realised that there are other data on economic and social matters which will influence statistics collected for fisheries work but which may not be readily available.

3

REPORT OF THE FISHERIES TECHNOLOGY COMMITTEE

by

Dr. D. V. Villadolid, Chairman of the Committee on Technology.

Fish Processing

At the Baguio Meeting it was planned that a more specific programme be brought into being by the chairman for circulation to various government representatives for comments and suggestions. It was also planned that the final programme would consist of the views agreed upon after the first draft programme had been fully considered.

An idea of the status of the processing industries and activities on fisheries technology has been gathered in general way from Dr. Kesteven's papers—Fisheries in South East Asia, [1] and Report on the Fisheries of Pakistan, India and Ceylon,[2].

1 Office of the Commissioner-General for the United Kingdom in South East Asia. July Liaison Officers' Meeting, Paper No. 1. 8th July, 1948.

2 Report issued 19th August, 1948, Commissioner-General's Office, Singapore.

Certain salient facts from his report given below may be of interest to the members and upon which the Committee might wish to draw a programme for direct action:

1. "Processing methods vary in their efficiency and in cleanliness."

2. "In some parts of the area they (methods) involve a considerable degree of wastage."

3. "Some of the processing methods produce most unattractive products and involve considerable wastage, and it is known that such products can command only a very low price from a relatively small market."

4. "It would be the height of folly to propose an immediate change in these methods."

5. "A much clearer understanding of these methods must be available in any programme of development of that industry."

6. "....the methods employed for processing fish are not satisfactory, from the point of view of efficiency or hygiene and that the products could be improved in many ways to increase their appeal."

It follows therefore from the above that this Committee might recommend for the consideration of the members of the following programme for direct action on a short range plan:

1. Survey of processing industries and the handling and transportation of fish, keeping an eye on every step of the process which may have possibility of mechanization to attain efficiency and/or may have to require improvement to prevent wastage. From this survey a compilation of descriptions of methods of fish preservation in the Indo-Pacific region may result. From this compilation the committee might wish to make a classification of the methods for uniformity in accordance with accepted English terms.

2. Gradual implementation by the establishment of experimental and demonstration stations for fish preservation methods and/or mobile units that may demonstrate proper methods of fish preservation and utilization of fishery by-products in different fishing centres during the fishing season.

3. Gradual adoption of regulatory measures to effect cleanliness and sanitation in fish processing and fish by-products plants.

FISHERIES GEAR TECHNOLOGY (FISH CAPTURE)

The committee might consider the following programme for consideration:

1. Increasing the efficiency of methods of fish capture by adoption of up-to-date methods, modifying these wherever possible to conform with existing conditions, and mechanization of operations if possible.

2. Motorization of fishing boats to increase radius of operation and to shorten cruising time to reach port so that spoilage in transit may be avoided.

3. Survey of fishing grounds for both demersal and pelagic fishing outside territorial waters.

PISCICULTURAL TECHNIQUE

In the event of emergency when for certain reasons fishing operations has become paralyzed, it has been found that fishponds serve as the most stable mainstay of a country's fish supply. There are extensive swamps in brackish water regions which may be converted to fishponds for brackish water species, as *Chanos chanos* which is widely cultivated in the Philippines and Java. The committee might therefore consider the following long range programme on this line:

1. Survey of the presence of sources of supply of *Chanos chanos* fry.

2. Training of personnel in piscicultural techniques to handle the activities in this line.

3. Survey of the location and extent of brackish water swampy areas for eventual exploitation.

4. Establishment of demonstration fish farms for *Chanos chanos* at strategic places.

5. Implementation of the programme with the co-operation of other entities of the respective governments concerned with the disposal of the swampy lands to facilitate disposal of these lands and encourage the project.

4

PROPOSAL FOR ESTABLISHMENT OF A PANEL OF EXPERTS. BUITENZORG MEETING, RESOLUTION VII

The Buitenzorg Meeting passed the following Resolution:—

Resolution VII.

Whereas the factor which most seriously hampers progress of research and development programmes of this area is the lack of trained personnel so that there is a need to make the fullest use of all available persons.

And whereas also it is desirable to make the fullest use of the experience of the leading worker in each field;

This Meeting resolves

To recommend to the Indo-Pacific Fisheries Council that it establish a panel of names of specialists to be a reference point for the subjects in which they specialise, to give directions in method of observation and collections made in the area; such a panel would be received from time to time; a tentative list is attached as annexure to this resolution, and the Secretariat is directed to communicate with the people named on the list to ascertain their willingness to act in the capacities indicated in this resolution.

This Meeting further resolves

To recommend to the Indo-Pacific Fisheries Council that it endeavour to arrange that whenever collections are made in this area, duplicate material should be retained in the area under the supervision of the specialists concerned with the groups represented.

HYDROLOGY

PHYSICAL — P. Ch. Veen, NETHERLANDS

CHEMICAL — D. Rochford, AUSTRALIA
Dr. M. van Raalte, NETHERLANDS

BIOLOGY

PLANKTON — H. Delsman, NETHERLANDS

ALGAE — J. Zaneveld, NETHERLANDS
Mrs, Valerie Jones, AUSTRALIA

PORIFERA — H. Srinivasa Rao, INDIA

MOLLUSCA — Mrs. Thera van der Feen, NETHERLANDS
Miss Joyce Allen, AUSTRALIA

CRUSTACEA — M. Tweedie, SINGAPORE
K. Sheard, AUSTRALIA

HYDROBATHIDS — M. A. Lieftinck, NETHERLANDS

ECHINODERMATA—
J. Fisher, CALIFORNIA
E. Mortensen, DENMARK

TUNICATA — H. Thompson, AUSTRALIA

PISCES — Dr. S. L. Hora, INDIA
Dr. J. D. F. Hardenberg, NETHERLANDS
G. P. Whitley, AUSTRALIA

REPTILIA — M. Tweedie, SINGAPORE
P. E. P. Deraniyagala, CEYLON.

AVES — C. Gibson-Hill, SINGAPORE
D. L. Serventy, AUSTRALIA
C. J. Manuel, PHILIPPINES

MAMMALIA — T. Vervoort, NETHERLANDS
H. van Deinse, NETHERLANDS

In accordance with the above resolution a circular letter was addressed to the persons listed. This letter quoted the resolution and went on to say:—

"You will see that this resolution proposes that the I.P.F.C. should establish a panel of

names of specialists who should be asked to undertake certain duties and obligations. You will observe from the tentative list which is attached hereto, that the meeting proposed that your name should be included in connection with.....

The meeting instructed me to communicate with you to ascertain whether, in the event of the I.P.F.C. adopting this recommendation, and agreeing to the inclusion of your name on the list, you would be prepared to accept such nomination and to act in the capacities indicated in the resolution.

You will recognise that this proposal is in only a most tentative stage and that the Council may adopt the suggestion in its entirety or only after substantial modification. You may perhaps have some views on the practicability of this suggestion or on the wording of the resolution, and if you should, I would be most grateful if you would communicate these to me so that I might present them to the Council or one of its committees."

Replies conveying willingness to undertake the necessary work have been received from the majority of the persons named. Dr. Fisher declined, but suggested alternative names.

5

A PROGRAMME OF SOCIO-ECONOMIC RESEARCH FOR THE FISHERIES OF SOUTH EAST ASIA*

1. Definition and Relationships of the Study.
2. Descriptive Phase.
3. The Operation of the System.

There is urgent need, in the countries of South East Asia, for a thorough study of the socio-economic factors of the fishing industry. The need exists because, *inter alia*, the socio-economic factors are the most important in the fishing industries of this area and the most susceptible of direct action. It is urgent because of the seriousness of the prevailing world food situation.

Among the fisheries of the world those of South East Asia are characterised by the primitiveness of the equipment employed (with consequent limitations on the geographic range of the operations and, further, on the types of stock exploited) and by the numbers of men engaged. There is relatively little mechanisation for motive power, for haulage or for processing; in general, power is provided by either men or wind, and by modern standards production efficiency is low. There is thus a considerable emphasis on human aspects of production, and many of the problems of the industry stem back to the human factor. Whereas in other countries the critical questions are chiefly technological, relating to the apparatus for seeking, capturing and handling the fish, here the questions of personnel are of greatest importance. The problems of the resource are not greatly urgent here; there is generally ample evidence of the scope for immediate expansion of the industry, in all its geographical and ecological divisions; nor is there immediate fear of depletionary conditions developing. Again, there is considerable scope for the introduction of modern apparatus to the industry; this will include modern vessels, with diesel engines, mechanised apparatus for handling fishing gear of modern design, echo-sounders, asdic and so on for navigation and for seeking fish; but the urgent problem is not so much a technological one of how to effect introduction of such apparatus, as a social and economic one of what introduction would be judicious at this stage and of what would be the effects on the existing industry of such introduction.

It may be stated categorically that the primary requirement in this area is a profound understanding of the structure and organisation of the industry: the status of employed persons, their work and their reward, especially their training and their skills, and their relations with their employers; the ownership of capital equipment; the distribution of earnings; the control of finance and so on.

1. DEFINITION AND RELATIONSHIPS OF THE STUDY

As suggested by this preamble, and by its name, this study will be concerned with the examination of the social and economic elements of

* A Regional Study by G. L. Kesteven, F.A.O. Regional Fisheries Officer for Asia and the Far East.

the fishing industry. It will be concerned with these elements only as parts of the socio-economic complex and not for themselves, or their inner structure, except insofar as these might effect their role in the socio-economic complex. Thus this study is concerned with boats only as so many units of fishing power, or transport capacity, of such and such a level of efficiency; on such questions it will accept from the technologists the results of their work. Again, medical and other aspects of the human elements fall beyond the purview of this study.

This study will therefore be concerned with social and economic elements of the fishing industry; it will enumerate and classify these elements and describe their relationships; it will then proceed to a description of the operation of these elements, their interaction one with the other and their response to external elements.

It will be well to state some of the work which will not be carried out under the name of socio-economic studies. Thus the study will consider fish solely in quantitative terms of the available amount of different kinds of fish: questions of how the volume of the composition of the catch might be determined by natural conditions do not concern this study, although the influence of manpower, of various levels of operational efficiency, on the volume of catch is germane to the study. Again, the design of the various units of the equipment, vessels, nets and so on, is not the concern of this study. Again certain realms of sociology and economics as such are not to be included within the limits of this specialisation. From all of these adjacent studies, socio-economics will draw such description or measurement of these elements as may be necessary to effect proper enumeration and classification of them and description of their relationships. Further it must be accepted that much of the enumeration work is the responsibility of administration whose normal apparatus of registration, licensing and collection of data should furnish the raw material of the study. However the results of the study will give some guidance in the task of gathering the data.

2. DESCRIPTIVE PHASE

The first part of this study must be to ensure the availability of reliable statistics relating to the various elements. These elements may be listed as follows:—

A. *Production*:

a. Catch; dissected according to species and locality; given for specified units of time;

b. Men engaged; classified according to occupation, wages, etc.;

c. Boats; classified according to size, design, motive power, carrying capacity and type of fishing for which employed;

d. Gear; classified according to types;

e. Finance; classified according to nature, source, use.

B. *Distribution*:

a. Supply; dissected according to class of fish (method of capture, market for which caught, etc.), channel of distribution;

b. Men engaged; classified according to occupation, wages earned etc.

c. Equipment, classified as for transport, storage or processing, and describing capacity, power required;

d. Finance; classified according to nature, source, use.

C. *Organisation*:

A classification and enumeration of the units of organisation from the family as a fishing unit, through teams and village organisations, companies of varying legal status, co-operatives and so forth.

It may be expected of the administrative divisions that they will engage on the collection of statistics relating to each of these categories; in some sections assistance will be obtained from the biologists and technologists for the accurate specification of the categories into which the data must be fitted; the economist must grant similar assistance in respect of wages, prices, finance and other essentially economic elements.

It must be recognised that there are considerable difficulties in the way of collecting statistics in this part of the world; all the problems of unsatisfactory methods of weighing, lack of uniformity in terminology, inadequate private records, reluctance to divulge information, which are met in other parts of the world are accentuated here. And this is true not only for the weighing systems and so forth in themselves, but is increased by the character of the industry and the dispersion of all its units. It is necessary to develop special techniques for the col-

lection of statistics, based upon close contacts with the fisherfolk and requiring a recognition of the value of incomplete sampling practices and of qualitative results. In the early stages such results can contribute much toward the description of the industry and can lay the basis for extended programmes.

When the full range of these elements is established it is essential that their nature should be understood to a sufficient degree and in this phase there must be continued and full co-operation between the economist, biologist, technologist and so forth. This co-operation will not cease upon reaching the first understanding about these elements, but will continue as long as these investigations should be necessary.

There already exists a substantial body of descriptive work relating to the boats and equipment of the fishing industries of this area; however, much of this material suffers from inadequate understanding of the uses of the equipment and of the need for exact technical account of construction and operation: much can be done therefore by the technologists in examination of the gear and methods employed in this area, and the results of their work will greatly assist other workers. This is particularly true in respect of the equipment and methods for the preservation and processing of the fish.

Statistics in respect of the quantities in each of the categories will be collected in time units of magnitude determined by the variability of the quantity in each category; thus a twelve month time interval may be sufficient for certain items, whilst a weekly or even a daily interval may be necessary for specific purposes for certain categories. Again the size of the geographic area, in respect of which the statistics will be collected, will depend upon the variability of the categories along geographic co-ordinates. Determination of this will depend upon the degree of development of the programme and upon the particular requirements of the investigations.

Between these elements we may recognise various relationships for which the following classification may be used.

1. Institutional Relationships: that is, those which exist by virtue of legal, social or other convention. Among these will be that of *ownership*, between men and their their catch, boats, gear and finance; employer-employee; buyer and seller; and the general relationship between the fisherman and the community to which he belongs.

2. Technical Relationships: as between classes of boats and classes of equipment.

3. Causal Relationships: that is, the operative relationships of varying degree between independent and dependent variables. Thus there is a fairly close relation between numbers of men and the numbers of boats, the amount of gear and of finance; there is a less close relation between these categories and the amount of catch. These relations can be measured statistically, and indicate that the existence or operation of one category will cause or be accompanied by the presence of another category, even though the response of the other need not be precise. The fishermen do not *cause* fish, but their work results in *catch*, and the relationship, which may be measured as between units of effort and amounts of catch, may be very close or very loose.

These relationships are of very considerable importance to any attempt to understand the fisheries of this area. The nature of the problem and the value of the work along these lines can be seen from Raymond Firth's book on the Malay Fisherman, in which considerable attention is devoted to the organisational features of the particular community which was studied. The relationships between owners, financiers and others on the one hand, and the fishermen, as operatives, on the other, are dealt with at great length and provide considerable matter for thought. Throughout the area the status of the fisherman in the community is a matter deserving close attention; this is not merely a matter of financial condition: in India it has been and to some extent still is an aspect of the caste system; traditional usages in this connection prevail throughout the area. Again, the role of the owner-financier and of the dealer-financier is of great importance and one which must be well understood before measures may be proposed in connection with financing, marketing and so on. Thus the towkays of Malaya and the laans and hongs of China are organizational phenomena which should be fully understood; the role which they play in the industry is an important one: whether the manner of playing it is not in the best interests of the industry is a question which could be answered satisfactorily only after proper study, and any proposal for serving the industry with alternative organization should have proper relation with the remainder of the industry's tradition and organization. Analysis of this kind is essential also for any programme for the development of co-operative organizations or large-scale companies. The history of the Japanese fishing industry, with its twentieth century development of fishing societies, co-operatives and large-scale highly capitalised and highly organised fishing companies (for salmon fishing, high-seas fisheries and whaling) will furnish object lessons on the problems involved in this section of the industry. It seems to be true that small units, developed largely on co-operative principles, are the

most appropriate manner of organisation of inland, coastal and other fisheries in which native, traditional methods of operation persist and in which the assimilation of new techniques is much slower than is the case for high-seas fisheries.

It must be pointed out that the importance of these institutional relationships is a matter itself for investigation: that is to say, they are of significance not only for the general organisation of the industry but also for the effect which they have on the movement of the fish supplies, or producer and consumer supplies, and finance, and these effects must be measured in themselves.

3. THE OPERATION OF THE SYSTEM

The foregoing may seem like an anatomical account of a static body; the real interest of this system however lies, in its operation—in the movement of supplies of fish through it, its assimilation of supplies of various commodities required for the production of the supplies of fish, and its use of finance. This operation may be considered from two points; firstly, the historical descriptive and secondly, by measuring, quantitatively, the relationships between the different elements and their effects upon one another, these being far from simple and operating to the third and fourth degree and beyond.

3.1 **Historical Descriptive Section:** The first task here is to describe the passage of the fish through the system. Such a description may first of all relate to the fish as physical entity; it will begin with so much crude catch, of which a proportion may be rejected as entirely useless, from then on the volume becomes steadily reduced according to the type of system, until an amount of edible food is eventually delivered to, and eaten by the ultimate consumer. The proportion of the catch which is discarded as offal varies widely in different countries, and also between sections of the industry; a realistic measure of this is desirable. The practices which are followed in handling, storing, preserving, transporting and processing vary greatly and require careful investigation by technologists and others, and understanding by the economist. The amount of wastage which results in the various stages must be measured by the economist. In this area more effective use is made of a wider range of natural types than in other (western) countries; a great deal of small fish, and of species which westerners regard as unpalatable, is consumed; moreover there is generally more efficient use of the whole fish. The flow of fish supplies may be regarded as being diverted, in varying proportions, and through various channels, to the ultimate consumers; from each channel there is always some measure of leakage. The greatest proportion of the catch in this region is of low price variety; the relation between the different price categories would warrant some investigation.

The movement of fish through this system may be described in terms of costs and of profits and prices charged at various levels. In this process, a basic price obtained by the fisherman, and from which he must meet his operational and personal costs, is added to, stage by stage, through this system and eventually becomes the price which the consumer pays; the process should be the reciprocal of the diversion of the flow to various consumers.

The second task in this section is to describe the functioning of the system through periods of time. This requires the collection of continuous series of statistics; these must be plotted as time series and secular trends must be calculated; the existence of rhythms, of any period whatsoever, must be detected.

3.2 **Examination of Relationship:** From the last mentioned sets of statistics, tabulated and graphed as time series, and in which rhythms have been detected and measured, the investigation must proceed to calculation of the degree of relation between the movements of the different series. Whilst there may be a close and fairly reliable relation between the available records of any two series in a section of time, this may be merely statistical and it may be unsafe to extrapolate beyond the limits of that time section. This means that the nature of the relationship between any two series must be understood and the significance of the statistical coefficient of correlation must be assessed on grounds other than only statistical. The more obvious relationships which will be examined will include:

1. catch and men, catch and vessels, catch and gear; from these there must evolve calculations of effort expended and of catch per unit effort, these will involve correlations between three and four variables.

2. between the volume of supply passing into various distributional channels; for example, fresh fish trade and processing, or, within the fresh fish trade, between different price levels.

3. between volume of supply and price levels; also between costs and prices, and subsequently multiple correlations involving all three and also other economic and social factors.

6

FISH MARKETING IN BATAVIA*

1. Introduction
2. The Market Premises
3. Control of the Markets
4. The Supply of Fish
5. Market Operations
   (a) Physical Movement of the Fish
   (b) Auction Practice and Record Systems
   (c) Market Staff and Operational Costs
6. Subsequent (post-auction) Movement of the Fish
7. Prices and the Dealers
8. Other Official Activity Associated with the Market
9. The Tanjong Priok Market

1. INTRODUCTION

During a brief visit to Java in connection with the work of the Indo-Pacific Fisheries Council, the opportunity was taken to make a study of the organisation of the market in Batavia. Requests had been received for detailed information on marketing practicés of this area, and an effort was being made to meet them by collecting whatever published reports might furnish this information and by supplementing these with special surveys where necessary. This study is one of the latter. Information had already come to hand indicating that much valuable experience had been gained in Java in the marketing of fish, and it was therefore believed that a study of the methods there employed would prove of great value.

Whilst practically all of the methods referred to here were observed by the writer, the bulk of the material consists of information supplied by Dr. J. Reuter and Mr. van der Wal of the Division of Sea Fisheries of the Department of Agriculture and Fisheries. These officers were at considerable pains to make me fully informed of the details of the scheme. I understand that they are jointly responsible for development of the scheme in i s pre ent form. Before the war, marketing in Batavia was organised by the municipality, but after the war the Department of Economic Affairs took over the market and administered it, placing emphasis on socio-economic aspects.

2. THE MARKET PREMISES

The market premises are situated at Pasir Ikan at the northern edge of Batavia. The market site is roughly triangular and is bounded on two sides by water; one of these water frontages is on a canal which communicates with the sea, the other is a backwater in which fishing vessels are moored. Both water frontages carry wharves to which the fishing vessels tie and on which the fish is discharged. The third side is occupied by general market premises, of the usual type of the region, where the fishermen may purchase their consumer and producer goods.

The general dimensions and lay-out of the market are given in the diagram (Figure 1). It will be seen that the auctioning floor occupies a great deal of the floor space; there are the usual accountancy offices and stores for fishing gear and space in in which the buyers can sort their purchases.

The main auctioning floor is closed off by a low fence of metal tube and netting, with appropriate entrances. There is access to this floor by large doors on the wharf side; these are used for bringing the fish for sale. The auctioning floor is divided into three bays, separated by the low fence; each bay contains three low "plaforms" on which the fish are laid out in heaps for selling. The platforms are marked off by a shallow path or gutter, about four inches deep; they are made of stone, which is very smooth and kept clean; walking on the platform is kept to a minimum. In addition to the selling platforms, each bay has an area, on the wharf side, where the booking clerks, cashier, and so on, do their work.

The diagram shows the relationship of the buyers' sorting-out area to the auctioning floor, the buyers' entrance and exit, the stores, offices, and so forth.

At present the market handles supplies amounting to about 3.2 million kilos per year. It would appear that the physical facilities and the administrative arrangements are such that the market could handle an increased volume of supply. There is only very small holding space; about 8 tons could be held at 1°C.

3. CONTROL OF THE MARKETS

The markets are the property of the Municipality of Batavia. Until recently the market operations were conducted by the Division of Sea Fisheries

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of the Department of Agriculture and Fisheries with staff who were originally part of the establishment of the Department of Economic Affairs and lately unattached. However, as from August,* the Municipality assumed control of these operations, but obtained technical guidance from the staff of the Division of the Sea Fisheries of the Department of Agriculture and Fisheries. The market, therefore is at present a municipal function, and the unusual situation exists that by virtue of the arrangements established for the implementation of a socio-economic programme through the machinery of the market, strengthened by the success which that programme has met, the Municipality will now undertake socio-economic work in the fishing industry.

It is important to emphasize the significance of the principle guiding the administration of this market. In point of fact, it can be considered that the actual sale of fish is secondary to the main purpose of the market, which is to afford facilities to the fishermen in the conduct of their profession.

4. THE SUPPLY OF FISH

The Batavia market receives something in the order of 3.2 million kilos of fish per year. This volume of supply is low at present because of the transport difficulties; when these are overcome it may be expected that the supply will increase to at least twice the present level. The supply includes brackish water fish as well as sea fish; it includes a wide range of species captured by a variety of fishing methods. No direct information is obtained as to the locality in which the fish is captured, but report is made of the method by which it has been taken. This supply comes from people living in other parts of Java and Batavia. Actually, there are very few fishermen resident in Batavia, but the outside fishermen are attracted to the city by the higher prices offered and the availability of consumer goods.

A small proportion of the Batavia market handlings is drawn from the Tanjong Priok market, where prices are somewhat lower than in Batavia and permit a profit even with the extra transport costs. The bulk of the discharge at the market is sold on the day of arrival and only a small proportion is held over; holding is for only one night.

The practice is that the fish which is sold wholesale on one day is retailed on the following day. This is based upon the retailer's programme of moving about his district in the early morning to sell his fish to the housewives, and then, after having disposed of his purchases, proceeding to the market to replenish his supplies. For this reason, the market commences operations at 11.00 a.m.

The fish is brought to market by the following methods:

A. *By Water*

(1) By fishermen; sailing and motor vessels of all sizes.

(2) By fish carriers; using sailing and motor vessels, giving simply transport services.

(3) By fish buyers; using sailing vessels, providing transport and a buying service.

B. *By Road*

This supply is chiefly from the tambaks and is brought by shoulder load, bicycle, car, truck and horse-drawn vehicle.

In these various modes of transport, the following in-board handling techniques are employed.

(1) Some fishermen (the majority) have no ice or other facility for preserving the fish; after capture it is immediately stowed below deck and left there until discharge; these fishermen engage only in day fishing and must return before 5.00 or 6.00 in the evening.

(2) Some fishermen have an icebox in which the fish is stored between layers of ice; the vessel returns to port when the box is filled.

(3) Some vessels carry salt, but this is used on board only in emergency, such as in the event of there being an excessive distance to travel, or a feeble wind, both of which mean delay in delivery.

It is to be borne in mind that the market does not receive the entire catch of the area from which its supplies are drawn; a proportion of the catch is processed on the neighbouring islands, and although the transport which brings the fresh catch to the market may also carry the processed (cooked in salt water) fish, the latter does not go through the market. However, the salt for this processed fish is purchased through the market.

The catch is taken by eleven or more different methods, all of which are of importance during some

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part of the year, but the palele and the muro-ami are of greatest general importance. There is seasonal variation in the volume of catch provided by each method; since the methods are generally fairly highly selective, the variations in the volume of catch from each are rightly identified with changes in the availability of the fish upon which they operate; the changes in availability of the fish are associated with the behaviour of the fish and the effect of environmental conditions (for instance, prevailing winds). It is clear that the statistics from these operations will be valuable data in biological investigations and, conversely, that the biological investigations will yield crucial information leading to an understanding of the fluctuations in supply and probably to prediction systems.

The principal fishing methods are the following:

a. Motor majang (pelagic)

b. Sailing majang (pelagic)

c. Djharing (pukot, gill nets, djaboer, djeharing pukit)

d. Sero (traps)

e. Pantjing (hand lining)

f. Muro-ami (reef fishery, with fixed net)

g. Bubu (littora set traps)

h. Sodok (scoop net)

i. Pelele (buying direct from fishermen at sea)

j. Djala (cast net)

k. Empang (Tambak; Blackish water ponds)

Whilst these methods are selective and specific, there is some "interaction", and, for instance, the mackerels, *Scomber kanagurta* and *S. neglectus*, are caught by sero on the full moon and by the djharing pukot on the dark.

The market supply is made up of many different kinds of fish. The market records show 69 different species plus an item for mixed fish. It is certain that the total number of species greatly exceeds 70, but many of these appear only in small quantities. The neighbouring market at Tanjong Priok, which previously listed only 52 species, now lists as many as Batavia, but it receives really a more restricted range of species. This is chiefly because the motor majang and the muro-ami vessels do not ordinarily supply Tanjong Priok because of the absence of harbour facilities for fishing vessels at the latter city. Because of the selectivity of these fishing methods, the absence of catch from motor majang and muro-ami has a considerable influence on the composition and the volume of the supply available to Tanjong Priok. Of the 69 species listed at Batavia, some 14 to 18 appear in quantities greater than 1% of the total supply. The variation in this relative magnitude of supply of important species may be shown by the following figures for the first half of 1948.

In January,* 18 species exceeded 1% of the total weight of supply, in February, 17; in March, 16; in April, 14; in May, 14; in June, 16.

These variations are chiefly the consequence of the fluctuations in the catch of a few dominant species which represent large percentages of the total. The Teri (*Stolephorus sp.*) Selar (Carangid spp.) and Ekor Kuning (*Caesio sp.*) are among the most important of the Batavia species.

Detailed statistics are kept of landings (i.e. discharges at the market) and these include data on method of capture and weight of each species. Compilation and analysis of such records is proceeding continuously and it is to be hoped that a full report will soon be made giving effective valuation of the seasonal fluctuation in supply and its correlation with species and method. The influence of economic conditions on these elements should then receive attention.

5. MARKET OPERATIONS

As stated above the market is operated entirely under local government administration. The following therefore is the official plan of operation in respect of receipt, display and auctioning of the supply and the maintenance of the accounting system. It is not supposed, or pretended officially that there are no malpractices in the operation of the market or in the subsequent disposal of the supply, but every effort is made to eliminate the opportunity for them in the market.

(a) **Physical movement of the Fish.** At the wharf the fish is discharged into baskets each carrying roughly 50 kilos of fish. In this process of discharge and placing into baskets, the fish is sorted into species. The baskets are then weighed and the total weight of each species in the load is recorded. The fish is then carried to the auction platform and is laid out in heaps, each of about 10 kilos. The small fish however are kept in baskets. The heaps of fish are placed in neat rows and the heaps from each vessel are kept together so that the whole

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of the fish from one vessel may be sold before the fish from the next vessel is put up for auction. The fish may be sold in single lots or in groups of lots. The fish may be removed as soon as auctioned, and, provided purchase money has been paid, may be removed at once from the market. It is a general practice for buyers to band together and purchasing different species of fish separately, to split their lots so that each may then have a supply of several species; this sorting is done on the open market floor on the area marked in the diagram. Coolies employed by the market assist at the discharge and sorting and placing out in heaps. Their service is free of charge to the fisherman.

The market records show that for 1947, 64,000 individual discharges of fish were made at the market and that the fish so discharged was laid out in approximately 400,000 selling lots; that is 6.25 lots per discharge (or 62.5 kilos).

Some of the fish, arriving late at the market, or for some other reason, is not sold on the day of discharge but held over. Such hold-over never exceeds 24 hours. In the case of vessels with ice-box the fish may be held on board over-night. For those vessels which have no ice-box, icing and storage for hold-over is done at the market; some of it stands iced in ordinary boxes on the market floor, but in the case of motor boats, especially those which operate the muro-ami, the fish is packed in boxes with ice and is stored in the refrigerator at +1°C.

(b) **Auction Practice and Record Systems:** The fish is auctioned to the highest bidder by an official auctioneer employing the ordinary system. The buyers remain outside the auction bay to bid, but enter to pay for their purchase and to remove it. The fishermen remain on the wharf side of the auction bay until their fish is sold and the cash received, whereupon they enter and collect their money in the procedure described below.

There are three selling teams on duty for part of the day and one team remains on duty during the afternoon to take care of late sales. Auctioning at the various platforms takes place in a system of rotation: the fish on platform A of Bay 1 is sold first, then Platform A of Bay 2, followed by platform A of Bay 3, then B in 1, B in 3 and so on. In this way auctioning takes place continuously but whilst it is taking place in one bay, in the other two bays fish is being cleared away by the buyers, new fish is being laid out, and the accounting work is being checked and completed, including the collection of the cash from the sale. This prevents the auction becoming confused. Moreover, this staggered sale enables buyers to arrange for continuous attendance where they wish. Above all, the alternate selling and checking ensures speedy detection of errors in the records.

As described above, the fish is sorted and placed in baskets on the landing wharf; it is then weighed. For each discharge the weighing clerk prepares a weight slip (in duplicate) which sets out the following information:—

1. The name of the dischargee: fisherman, carrier or buyer.
2. The method by which the fish was caught.
3. The weight of each species.
4. The total weight.

The original of this weight slip is handed to the dischargee who holds it until it comes to the turn for his fish to be auctioned at which time he hands the weight slip to the auctioneer's assistant; no fish is auctioned without presentation of the weight slip. In exchange for the weight slip the dischargee receives a wooden slip carrying a number identifying his parcels of fish. The movement of this wooden slip will be described later. The dischargee is held responsible for his fish in the market until he receives the wooden slip; at that time responsibility passes to the market.

The auctioning team consists of the following persons:—

1. Overseer
2. Cash register operator—group chief.
3. Cashier.
4. Auctioneer.
5. Crier.
6. Auction bookkeeper.
7. Ticket writer.
8. Statistics clerk.
9. Board writer.
10. Mandoer.

During the auction the auctioneer, the crier and the statistics clerk are on the auction platform; the auction bookkeeper is seated in a spare space of the bay, away from the cash register; the cash register operator is seated behind the cash register in the recess on the wharf side of the bay, on his left is seated the ticket writer and on the left of the ticket writer, in a small cage, is the cashier; the board writer stands at the blackboard at the inner end of the bay; the overseer and mandoer move about as required. The auctioneer, accompanied by his crier and statistics clerk, moves about the auction platform up and down the rows of heaps of fish. He carries a stick with which he indicates the fish

up for sale and invites bids; the fish may be sold in single heaps or he may sell a group of heaps together. His crier calls the number of the dischargee's lot when auction first begins on it, then for each transaction he calls the name of the successful buyer and the price at which the fish is sold in each heap or lot of heaps. The mandoer keeps a record of the number of heaps set out and the manner (single or multiple) in which they are sold. The statistics clerk keeps the weight slip and on the back of it he writes the price of each transaction. The board-writer writes the dischargee's name and number and the name of the buyer and the price for each transaction; exactly the same information is entered in the auction book by its keeper. The cash register operator records first the number of the dischargee and then in sequence the value of each transaction; the machine prints this information on two copies of a continuous strip and also on a sales slip composed of an upper and lower part. The slip is coloured, separately numbered in its own sequence and in duplicate; one is printed for each transaction. The word "duplicate" here means that it is perforated at a point about one-third along its length, and the sales information is printed on each side of the perforations. As each slip comes out of the machine it is received by the ticket writer who inscribes on it the name of the buyer, and then passes it to the cashier.

When the fish on each platform are all sold, a rapid check is made of all these records. The blackboard record is held as a last check if required and is not expunged until the other checks are completed. The auction book record is checked against the cash register continuous strip. This strip is torn up into sections, each carrying the record of the sales of the fish of a particular dischargee; when checked, these sections are handed to the cashier who holds them to keep with his stubs of the sales slips.

As soon as the fish is sold, it may be paid for and removed. Payment must be made promptly. When payment is made, the buyer receives the lower part of the sales slip as a receipt. As stated, the stubs of the sales slips for the sale of each dischargee's fish are assembled and put with the section of the cash register continuous record. When all payments are made and the upper parts assembled the dischargee shows his wooden slip and receives the upper parts and the cash register strip. He takes all three to the commission calculator who makes an entry in a sub-cashbook of the dischargee's name, gross value of the sale, and charges to be made against it; he then calculates the net payment to be made to the fisherman and enters this on the cash register slip; the three (wooden slip, sales slips and cash register slip) are then returned to the dischargee who presents them to the head cashier who gives him cash in exchange.

It will be observed that the sales are recorded on the blackboard and the auction book. They are also recorded by the cash register on two continuous strips and on the sales slips, and some figures are entered in the sub-cash book. These books are carefully checked and cross-checked, and this work must be completed each day; no sales may be undertaken on any day if the previous day's records are incomplete. It is presumed unnecessary to attempt any description of the accountancy procedures adopted in handling the cash and the fiscal records.

The information given on the weight slip, listed above on p. 57, plus the value of the sales, is worked on in a section of bio-economic statistics where tables are prepared to show total sales, total sale of each species, quantity from each fishing method, and average prices by species and method. Information on the quantity of each species taken by each method can at any time be taken out of these tables as required. Graphs are prepared showing trends in supply and in prices. Some general information on area of supply can be deduced from these tables, by people acquainted with the habits of the fishermen. However, arrangements are being made to develop the records further to include data on the place of catch.

(c) **Market Staff and Operational Costs.** There are four auction teams of the size and composition listed above; there is always one of these teams on leave. In additions to the forty persons thus engaged, there is the following staff:

At the weighing scales—1 clerk and 1 mandore.

On the auction floor—2 mandoers for general oversight and 4 groups of 4 or 5 coolies.

In the statistics section—6 clerks.

In the socio-economic section—2 contact persons (Adj. consultants).

In the cashier's office—2 assistant cashiers, 1 cashier, and 1 chief cashier.

In the Office—1 Adj. consultant, 2 typist-clerks, 1 Administrator.

At the main gates—2 mandores.

The whole is under the supervision of a market manager.

Thus there are some 81 persons engaged on the floor. Their total basic wages are apparently in the order of f60,000, to which is added a further sum of f90,000, representing the cost of living adjustment which is allocated on the basis of marital condition and number of children. Further a sum of f45,000 is spent on food and transport for these employees, making the cost of labour in the market a total of f195,000. There is no information on the total labour cost of this operation, nor on what other charges have to be met. But against these costs, the market charges a 5% commission on all sales, which yields about f500,000 in the year. There are other sources of revenue.

6. SUBSEQUENT (POST-AUCTION) MOVEMENT OF THE FISH

The fish supply moves off in two courses. The bulk of it is termed kampong supply; it is taken away generally on head loads, or bicycle; each dealer carries a variety of fish and generally gets this by the arrangements, and sorting out, described above. The other supply is styled "western fish;" it is generally larger fish. None of the fish is gutted, cleaned or in any way processed on the market floor; it all moves off unaltered. No information was collected on the retail practices. The kampong fish is ten times in volume to the western fish, but only five times its value.

7. PRICES AND THE DEALERS

The market is open to anyone wishing to buy, and the only apparent limitation is that sales are made only of complete heaps (of 10 kilos). Buying for fresh fish trade for western and kampong consumers constitutes the bulk of the operations, but processors buy on the market and the market authorities can always be assured of a basic price and of being able to dispose of supplies through the processors. On the other hand, if the price falls too low, the Sea-fishery Institute may intervene and buy heavily to exercise a control on the market. It is stated that the Institute has never lost in such operations because the relationship between supply and demand, dominated by the day-by-day nature of the operations, is too close to allow either side to play hard and fast with the market.

It is probable that four million kilos of fish will be sold in the Batavia and Tanjong Priok markets during 1948, and this quantity would have a total value of f10,000,000 if an average price of f2.5 per kilo were maintained, but already there has been some recession from these prices. In May, 1948, first quality fish was sold in the auction for 2.62, medium quality for f1.20 and low class fish at f0.80. It would appear that there is a retail margin of anything from 100% to 300%, and that the margin is higher on the kampong class of fish than on the western.

8. OTHER OFFICIAL ACTIVITY ASSOCIATED WITH THE MARKET

The planning and directing of the activities of the fish market have been based on the principle that the fish market is traditionally the centre for trading and other activities for the fisherman. It is recognised that the fisherman has been accustomed to receive financial aid from the person to whom he has sold his fish, and perhaps also to buy from him his producer and consumer goods; this means that if administration undertakes the task of selling fish it must also accept these ancillary duties. Further, it is recognised that the principal selling point is of very considerable importance in maintaining contact with the fishermen and with the industry generally. The movement of the fish through the market furnishes information whose importance is greater than any other body of data; in addition to this, the financial condition of the fishermen can be kept under constant watch and their need of goods, financial aid, and so on, will readily appear at this point. Moreover, constant personal touch can be maintained through the market with fishermen, dealers, and so on. Recognition of these facts has guided the people responsible for this market, and the operation of the method can be observed any day at the market. An observer cannot fail to be impressed by the atmosphere and by the evidence of ready collaboration.

The market organisation (personnel) includes two special sections for socio-economic work. One section is on the market floor, as it were, and serves as a contact point for the fishermen to receive their reports of problems, requests for assistance, and so forth.

From this section the information passes to a section in the main office of the market where a decision is made and action taken for the granting of loans and credits, and other assistance. This assistance, when fully operating, will involve a fund of approximately f500,000. The recovery of advances made is effected through the cash system of the market, a deduction being made from the amount payable to the fisherman as the result of each separate market operation on his behalf.

The market authorities undertake to look after boats and goods left in their care; the backwater referred to in Section 2 is used for this purpose, and

space is reserved in the market for storage of sails, etc. This service is rendered free of charge.

Producer and consumer goods of various kinds are sold through the market organisation. These include sails, lines, hooks, and so forth, and in addition such goods as timber. An important item is the issue of salt, which is made pro rata on the basis of fish delivered to the market. The volume of business involved here amounts to something on the order of f50,000 per month. From time to time certain goods (such as clothing) are made available free of charge to the fishermen, and the distribution is made through the market. A similar programme of supply of producer and consumer goods is conducted by the Sea-Fishery Institute, and the two programmes are co-ordinated.

The market provides accommodation for the staff of the "Thousand Islands" Fishermen's Co-operative.

Free medical service is provided by the market, the entire cost of which is borne by the market. The Clinic for these services is, however, housed in the Sea-fishery Institute.

It is to be remembered that all of these services are provided without any charge to the fishermen. The cost of them is charged against the 5% commission from the gross proceeds of the sales.

9. THE TANJONG PRIOK MARKET

The market at Tanjong Priok is run along lines identical with those described above for the Batavia market. Its supplies are, however, much smaller, being only 25% (in volume) of the Batavia supplies. These supplies are drawn from a smaller area than the Batavia supplies and are taken by fewer methods. The demand is weaker at Tanjong Priok, and this fact, coupled with the fact that the supply and that transport costs to Tanjong Priok are lower, results in a generally lower price for the Tanjong Priok fish. As remarked above, this leads to a small diversion of fish into the Batavia market from Tanjong Priok. A further results of the weaker demand in Tanjong Priok is that the auction is obliged to sell the fish in smaller individual lots than the Batavia auction uses.

Before World War II there was an extensive chain of inter-linked markets along the north and west coasts of Java. It has not yet been possible to restore this chain, but, as noted above, the character of the markets has been developed substantially.

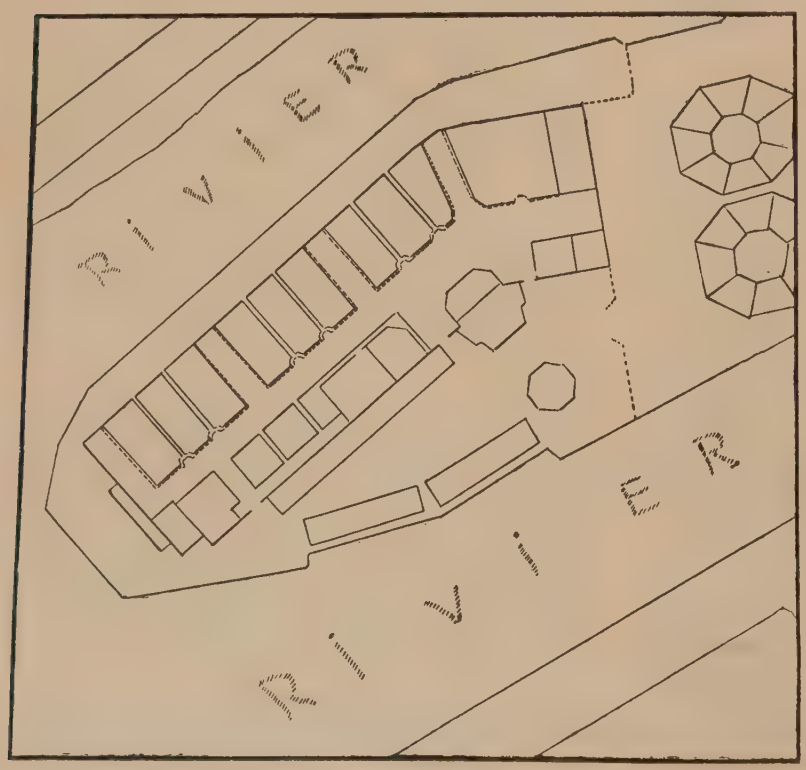


Figure 3.

Site of the fish market at Batavia. The right-hand side of the island is shown in greater detail in Figure 2. See page 38.

1. General view of the approaches to the market, which can be seen centre left.

2. The wharf at the fish market; fishing vessels tied up to discharge.

3. The fish being sorted at discharge.

4. The fish being weighed; the weighing clerk can be seen at his counter. The dial of the balance faces inwards to the weighing clerk.

PLATE I. THE FISH MARKET AT BATAVIA.

1. General view of the auction floor, showing four tally-blackboards on the left, the auction platforms in the foreground, and the fence behind the platform. Platform A of the Bay nearest the camera had just been washed and shows in the photograph as a gleaming surface.

2. The fish being set out in heaps prior to auction.

3. The auction in process. The buyers can be seen on the right behind their fence. The tally clerk is writing on the blackboard; the auctioneer's stick shows on the left.

4. Fishermen's boats left in the care of the market authorities.

PLATE II. THE FISH MARKET AT BATAVIA.

7

TECHNICAL COMMITTEE II

(Issued as Working Paper C49/16).

1. Proposal for the scope of activity of the Technology Committee.

The subject to be allocated to this Committee may be divided into four and subdivided further according to the fields.

SECTION I—Production
1. Boats and gear.
   a. Local boats and gear.
   b. Experiments with non-indigenous gear and other methods and equipment.
   c. Treatment and maintenance (research on gear and net efficiency and preservation).
2. Piscicultural techniques.

SECTION II—Storage and Processing.
1. Drying, salting and smoking.
2. Canning, Packaging and Refrigeration.
3. By-products.

SECTION III—Distribution and Socio-economics.
1. Distribution.
2. Finance.
3. Organization.

SECTION IV—To summarize existing documents on international law as they pertain to fisheries and to exchange information with regard to fishery legislation and regulations.

2. It was also agreed that the best way of tackling the problem speedily was to appoint working committees for each of these sections.

3. It was also agreed that the papers contributed to meeting falling under the Comittee II will be taken up as follows:

Tuesday, March 29th at 2:00 *p.m.*
1. Preliminary Report on studies of salted fish paste by Mr. J. I. Sulit and Mr. S. B. Santiago.
2. Notes on the experimental canning of fish at the fish preservation station, Estancia, Philippines by Mr. C. Martin.
3. Paper on refrigeration by Mr. W. B. Braxton.

Wednesday, March 30th at 10:00 *a.m.*
1. Note on the effect of explosives on fish in Siamese coastal waters by Mr. Boon Indrambarya.
2. Hongkong Fish Marketing Scheme by Mr. J. Cater.
3. Vitamin A and Oil content of some Philippine fish livers by Mr. C. Butler.

Wednesday, March 30th at 2:00 *p.m.*
1. Elucidation of the functions of working party on SECTION III by Mr. J. A. Tubb using IPFC/C49/5 and IPFC/C49/11 papers prepared by the Secretary.

4. Programme for the ensuing year—See IPFC/C49/8.

8

RECOMMENDATIONS OF TECHNICAL COMMITTEE I

(Issued as Working Paper C49/20).

I

The Committee on Hydrology and Biology recommends that Sub-Committees on particular problems take cognizance of and be guided by the following.

1. The basic structure of the Council's biological and hydrological programme must be related to national projects of research and development for which the Council would propose measures of coordination and integration aimed at ensuring that, wherever possible, the projects are complementary to

one another and yield a maximum amount of information of common value from the existing resources of personnel and equipment.

2. The Sub-Committee will need to apprise itself fully of the nature and scope of the national programmes and of the resources available for carrying them out.

3. The Sub-Committee, as a working unit, should formulate and state the specific problems referred to it and recommend assignment of priorities in the working programme, taking into consideration where appropriate:-

(a) Recognition of the interest in, and allotment of responsibility for geographic and subject units.

(b) Exchange of information on
1. Methods and equipment,
2. Results,
3. Conclusions.

(c) Adoption of standard methods of equipment and terminology.

II

The Committee on Hydrology and Biology recommends to the Council that co-ordinated efforts would be desirable in the scientific investigation of pelagic fisheries and considers that the following two groups of fishery resources need study from the point of view of collaboration by the member nations:-

1. The Tuna Fisheries
2. The fisheries concerned with the commercially important marine clupeids (including anchovies), scombroids other than tuna and pelagic carangids.

III

The Committee recommends to the Council the recognition of the importance of fish-culture in the Indo-Pacific area and the need for collecting and pooling information on biological methods relating to fish cultural practices in coastal, brackish water and inland areas.

9

RECOMMENDATIONS OF TECHNICAL COMMITTEE II

(Issued as Working Paper C49/21).

1. It was agreed to delete entirely in Working Paper IPFC/C49/16, Section IV.

2. With reference to the suggested terms of reference IPFC/C49/18, it was agreed to adopt (b) with the insertion of "statistics", making this No. (3), (3) becoming (4) and (4) becomes (5).

3. Proposed programme for the ensuing year.
Working Party I (Section I)

(1) Survey of local boats and gear with descriptive details.

(2) Progress reports on non-indigenous gear and other methods.

(3) Progress reports on research on gear, net efficiency and preservation.

Working Party II (Section II)

(1) Survey of processing industries with a view to improving efficiency.

(2) Progress report on canning, packaging and refrigeration.

(3) Progress report on byproducts

Working Party III (Section III)

(1) Synposium on current financial factors as they affect equipment, facilities and manpower in fishery production.

4. Proposal to insert the heading "International Fisheries Law" after Mammalia on Page 2, Working Paper IPFC/C49/9, and propose the names of Dr. W. E. S. Flory and Mr. E. Allen.

Section 3

CONTRIBUTED PAPERS.

		Page
1.	Notes on Fish Fry Industry of China	65
2.	Oceanography in the Indonesian Archipelago	72
3.	Indian Fisheries	73
4.	The Organization and Utilisation of Plankton Investigations	82
5.	Korean Fisheries—Their present and future	83
6.	Rastrelliger kanagurta (Ruppell)—Its Fishery and Biology—Summary of our knowledge—Study programmes	94
7.	The Problems of Fish Storage and Refrigeration in South East Asia	96
8.	General Review of the Fish and Fish Culture in the Continental Waters of Indo-China and Projected Programme of Work	101
9.	An Outline of a Preliminary Survey of the Socio-economics of the Fishing Industry of Hong Kong	104
10.	The Economic Algae of Malaysia and their Applications. I. Cyanophyta and Chlorophyta	107

CONTRIBUTED PAPERS.

*IPFC/C49/CONTR. 1. Notes on Fish Fry Industry of China, by S. Y. Lin.

IPFC/C49/CONTR. 2. Abstract, Replaced by IPFC/C49/CONTR. 17.

IPFC/C49/CONTR. 3. Withdrawn and Replaced by IPFC/C49/CONTR. 16.

IPFC/C49/CONTR. 4. Abstract. Replaced by IPFC/C49/CONTR. 19.

IPFC/C49/CONTR. 5. Abstract. Replaced by IPFC/C49/CONTR. 20.

IPFC/C49/CONTR. 6. Oceanography in the Indonesia Archipelago, by Cdr. H. W. R. Krauss.

IPFC/C49/CONTR. 7. On the food of the Bandeng (*Chanos chanos* Forsk) in Indonesian Ponds, by W. H. Schuster.

IPFC/C49/CONTR. 8. Note on the Effect of Explosives on Fish in Siamese coastal water, by Boon Indrambarya.

*IPFC/C49/CONTR. 9. Indian Fisheries.

IPFC/C49/CONTR. 10. Fish Culture in Ponds in the Territories of Hong Kong, by S. Y. Lin.

*IPFC/C49/CONTR. 11. The Organisation and Utilisation of Plankton Investigations, by H. Thompson.

*IPFC/C49/CONTR. 12. Korean Fisheries—Their present and future, by Chyung Moon Ki.

*IPFC/C49/CONTR. 13. Rastrelliger kanagurta (Ruppell) — Its Fishery and Biology — Summary of our knowledge — Study Programmes, by J. Durand.

*IPFC/C49/CONTR. 14. The Problems of Fish Storage and Refrigeration in South East Asia, by W. B. Braxton.

*IPFC/C49/CONTR. 15. General Review of the Fish Culture in the Continental Waters of Indo-China and the Projected Programme of Work, by L. Lemasson.

IPFC/C49/CONTR. 16. Preliminary Report on Studies of Salted Fish Paste, by Jose I. Sulit and Silverio B. Santiago.

IPFC/C49/CONTR. 17. Notes on Experimental Canning of Fish at the Fish Preservation Station, Estancia, Philippines, by Claro Martin.

*IPFC/C49/CONTR. 18. An Outline of a Preliminary Survey of the Economics of the Fishing Industry of Hong Kong, by J. Cater.

IPFC/C49/CONTR. 19. Bangos Cultivation and its Relation with Algae Culture in the Philippines, by D. V. Villadolid and D. K. Villaluz.

IPFC/C49/CONTR. 20. The Culture of Lab-Lab, the Natural Food of the Milkfish and Fingerlings under Cultivation, by Herminio R. Rabanal.

Only papers marked with an asterisk are published here.

Of the above Contributed papers, the following have been published elsewhere:

No. 7, Med. Alg. Proefst. Landb., No. 86, pp. 1-20, Buitenzorg, 1949.
8, Thai Fisheries News, 2(3): 17-24. 1949.
16, Philippine Dept. Agric. Nat. Res., *Popular Bulletin* No. 29.
17, ibid, No. 28
19, ibid, No. 30
20, ibid, No. 18

1

NOTES ON FISH FRY INDUSTRY OF CHINA

by S. Y. Lin

INTRODUCTION

The history of Pond Culture in China is very old. Fan Li, (范蠡) in his "Classic of Fish Culture", said to have been written in 475 B.C, related: "There are five ways to procure wealth; one of which is aquatic culture. What I mean by aquatic culture is fish ponds. A pond of 6 mows (about 1 1/5 acres) is built and partitioned into 9 sections. Plenty of aquatic plants are introduced and arranged in some zig-zag manner. Twenty full-grown and egg bearing carp (common carp, *Cyprinus carpio* Linn.) of 3 ft. long each and 4 males of 3 ft. long are then introduced in the second moon (March). By maintaining the water undisturbed the fish will spawn."

Although Fan did not mention the practice of collecting fish fry from the rivers and rearing of them in ponds as it is done today, yet a few centuries later Shi Ma Tsen (司馬遷) in the period between 140 B.C. to 88 B.C. definitely referred to this profitable enterprise of pond culture and strongly recommended it to the Emperor Wu Ti (武帝). He said that a thousand *shik* of fish could be harvested from a pond after one year's rearing. Actual records of fish fry collecting and transportation were made by Chow Mit (周蜜) in 1243 and Hsu Kwang Ch'ih (徐光啟) in 1639.

In recent centuries the practices of fish fry collecting in the West River and Yangtze River and of pond culture have been highly developed into one of the most important industries in the rural economy of China. It is estimated that from the two main rivers and tributaries 11,000,000,000 newly hatched carp fry and eggs are collected and distributed annually to different provinces of China, Siam, Singapore and Malaya. If only 5% of the fry collected should survive and grow to attain an average weight of one catty each, we should have a total annual harvest of 5,500,000 piculs (327,000 tons). The actual production may be bigger, which nurserymen usually expect, but there are no accurate statistics available at the moment.

As shown in the map, the West River and Yangtze River, with its origin in the Kun Lun Mountains (崑崙山脈), running through 8 provinces of China, covers a course of 3,400 miles. The South-East monsoon starts annually in April and brings heavy rain to the interior of China until September. Consequently the rivers rise in early summer and the temperature of the water is also slightly increased. Such changes of environment constitute important factors hastening the spawning of the mature fish inhabiting the rivers. The fertilized ova drift with the rapid current (travelling at 2 or 3 miles per hour,) and hatch usually overnight. Traps in the form of bag nets or troughs are set up along the embankment to collect them. Fry and eggs of many kinds of fishes enter the traps, but only those of the following species are selected and used:

1. Grass carp (鯇)
   Ctenopharyngodon idellus (C. & V.)
2. Big head (鱅)
   Aristichthys nobilis (Richardson)
3. Silver carp (鰱)
   Hypopthamichthys molitrix (C. & V.)
4. Mud carp (鯪)
   Cirrhina molitorella (C. & V.)
5. Black carp (青魚黑鯇)
   Mylopharnygodon piceus (Richardson).

The work of the Fish Fry industry can be divided into 4 main sections, namely, (1) Organization and Administration at the headquarters; (2) Collection of Fry; (3) Management of the Nursery, and (4) Transportation of Fry.

The following discussions are based mainly on personal observations made by the writer in the West River regions and pictures taken at Shiu Hing (肇慶) by Mr. Yu Yat Sam, Research Assistant of Hong Kong Fisheries Research Station.

ORGANIZATION AND ADMINISTRATION AT THE HEADQUARTERS

Each year the nurserymen start, in December or January, to organize a company or companies to handle the fry business. Firstly they set up headquarters, for administrative work; secondly the staff is selected and assigned to various posts in the Company; preparations for collection, rearing and distribution of the fry are then made. The headquarters establishment is housed in a big mat shed covering

an area of about 5,000 sq. ft.; it consists of a meeting room, an office, storage for tools, staff's quarters, kitchen and bathrooms. Guests and customers coming from different parts of the country (300 to 500 in number) are accommodated in separate quarters nearby. The central meeting room has a big shrine at the inner and farther end and people use this room to discuss business. There is an accounting room where payment is received on sale of fry. The Fish Fry company provides 2 meals free to all the staff members and workmen and for customers who come to the company and wait for fry. The dining hall is a busy rendezvous at meal time.

Pre-war there were 46 independent companies in Shiu Hing (肇慶); each employed 1 chief fry expert, 1 assistant expert and 6 to 10 workers. Post-war circumstances obliged them to combine into one single organization and to monopolize the fry business of that district. The new company employs practically all the best fry experts; the capital is about 50,000 dollars Hong Kong Currency in 1948, and is raised by shares, the holders of which are confined to the old 46 companies only. In 1948 only 36 joined the main company.

The company operates 16 fry collecting stations along the River in the Shiu Hing district, (prewar there were 72 stations). It is staffed by a manager who is an old fry expert himself, 4 assistant fry experts and 10 workers. The main concern of the company is to sell the newly collected fry to the travelling customers from different parts of the country. When all the travelling buyers have got what they want the surplus fry will be bought by the shareholders of the company. Each shareholder or individual company rears fry in his, or their own ponds and continues to carry on business by selling fingerlings to fish farmers.

COLLECTION OF FRY

Early in April the united company begins on the construction of 10 to 20 rows of high frames of china fir and bamboo poles on the bank of the river at each collecting station. Each frame is constructed of 10 to 16 vertical china fir poles 30 ft. long, spaced at intervals of 9 ft. each and strengthened by 3 or 4 horizontal poles of china fir or bamboo at intervals of 4 ft. 10 to 15 conical bag nets are fastened to each frame for collecting spawn from the river. The bag net is made of ramie netting of extremely fine mesh (actually it is a kind of ramie cloth) measuring 12½ ft. in length. The posterior end is connected to a still finer-meshed ramie netting box, 4′ long x 1′ wide x 1′ deep, which is suspended on an oblong wooden frame to keep it afloat. The body of the bag net is also kept afloat by inserting a pole of bamboo or china fir into the bag and any spawn either in the form of eggs or fry which are drifted into the bag pass along and collect in the box.

When large quantities of fry are collected in the end boxes, they are bailed out with a dip net and placed into a netting reservoir 5′ x 4′ x 4′, suspended on a wooden frame and movable as desired. The fry netting reservoir is then drawn near to the shore.

Fry are transferred from it into water-proof baskets with the help of a dip net and carried to the nursery ponds for sorting and distribution.

Before discussing the collection of other carp from the river, a brief account of propogation of the common carp, (*Cyprinus carpio*) will not be out of place here:

During the months of December, January and February a small pond (50 to 100 sq. ft.) is prepared firstly by draining it and destroying all harmful creatures, and then by re-filling it with pure water from a nearby source such as a river or a canal. The water should be filtered through a small meshed bamboo screen placed in front of the bars of the sluice gate. Then a good supply of aquatic plants should be put into the pond, for it is upon these plants that the eggs of the carp will later adhere. Fully mature fat-bellied carp are then selected from the main ponds in the ratio of 2 or 3 males to 1 female and transferred to the spawning pond. To ascertain whether a fish is mature, and ready to spawn, one should hold it in the hands, press the belly and should any sperm or ova come from the cloaca, then the fish is mature.

The carp spawn very quickly, normally in one or two days. As soon as the eggs are laid and fertilized, they must be removed immediately and placed in a nursery pond for hatching and rearing in the same way as is done with fry of other kinds of carp.

When in 1934, I made trips to the West River in Kwangsi with a view to finding out the possibilities of improving the fry industry of China, I discovered that eggs of the mature spawning grass carp (Wan Yue) are not sticky and adhesive like those of

The nets are tanned every fortnight or every month after they are used with cutch, Siu Leung (薯莨 a wild yam, *Dioscorea rhipogonoides* Oliv., or the bark of Yau Kam Tse (油金子), Myrobalan, *Phyllanthus emblica* Linn (Euphorbiaceae). The juice of Yau Kam Tze is stored in earthen pots for tanning purposes and a huge boiler is used for steaming the tanned nets. In Shiu Hing the bark of Yau Kam Tze is most commonly used.

the common carp and gold fish and could be artificially fertilised and hatched into ordinary fry for pond culture (Lin 1935). In the period 1936-40, a fresh-water Fisheries Experimental Station was established in Kweiping by the Kwangsi Government and experiments were successfully carried out on a large scale. In 1940, over 1,000,000 artificially bred fry were distributed to fish farmers in Kwangsi.

Every year, around the months of May and June, torrential rains cause the West River to flood and it is quite common for the river to rise more than 6 ft. in 24 hours. At this time many kinds of carp swim upstream to spawning grounds to breed. These carp are caught by drag seine nets or scoop-nets, and the ova and sperm pressed out by hand in order to effect artificial fertilization.

The method of collecting the ova and sperm for the purpose of artificial fertilization is quite simple. Two persons are needed, one to hold the female fish with one hand supporting the chest and the other grasping the head, whilst the other person holds the fish by the tail with one hand and with the other presses the belly so that the eggs flow out gently into a dry clean collecting basin. In the same manner the milt of the male is obtained and placed over the eggs. With a feather the ova and sperm are thoroughly mixed to ensure complete fertilization, and after a short interval, of 20 to 30 minutes, they are washed in clean water and placed in hatching boxes. These hatching boxes are made of ramie or jute cloth and are attached to an anchor and floated on the river. The fertilized ova will hatch overnight and the newly hatched fry are treated and reared as usual. Although the success of this artificial fertilization technique, using free, non-sticky ova, is of great scientific interest, no really practical value for it has been found. There are difficulties in procuring mature fish, and the number of ova which can be fertilized artificially is negligible compared with the quantity of fry or eggs collected from the river.

MANAGEMENT AND WORK AT THE NURSERY

When sufficient fry have been collected from the river, they are conveyed to the nursery ponds in water-proof baskets. The site for the nursery ponds should be as near to the collecting station as possible. Where eggs are collected, they are not transferred to the nursery immediately but are first placed in a "hatching box" similar in structure to the fry netting reservoir, made of ramie cloth, 6′ x 3′ x 10″.

The "hatching box" is suspended on a wooden frame to keep 1/3 of it afloat above the surface of water and is anchored at some sheltered spot in the river or at the mouth of a small tributary where the water is comparatively clear. In bright sunny weather the eggs hatch in two or three days; they are allowed to grow for another three days on the nutrition of their own yolk sacs and on plankton in the river. They are then conveyed to the nursery ponds for further treatment. The practice of egg collecting is known only in two places:

(1) Heng Yang (衡陽) on the Hsiang River (湘水) of Hunan Province.

(2) Tsaichi (果溪) near Ichang (宜昌) of Yangze River in Hupei Province.

(1) *Nursery Ponds* (魚花塘)—There are two types of nursery ponds, the partitioned and the unpartitioned or whole pond, each varying from 1 to 3 mows (1/5 to 3/5 of an acre) in area and with the depth of water 2 to 3 feet. The partitioned ones are reserved for temporary rearing young Big Head and Silver Carp fry for 12 or 13 days, and also for rearing young Grass Carp fry and Mud Carp fry for 24 to 48 hours. The material used for partitioning a pond is a kind of bamboo matting, each piece about 7½′ by 4′ and small bamboo sticks about 7 ft. long. One waterway in the middle divides the pond into two unequal compartments, one compartment is further divided into two long sections in the middle with one wider section on each end. The other half is divided into six equal compartments called Tar Tsai or small sections. For example a pond of 1½ mows measuring 120′ x 120′, i.e., 14,400 ft² is divided into sections according to the above pattern so that we would have the following areas occupied by different sections:

6 equal division (Tar Tsai or small sections (筲仔) each	45′ x 20′ = 5,400 ft²
2 long section (長筲) each measuring	55′ x 20′ = 2,200 „
2 wider sections (孖實) each measuring	55′ x 40′ = 4,400 „
1 water way (水路)	120′ x 20′ = 2,400 „
Total area of the pond	14,400 ft²

The area of the Tar Tsais, the waterway and long sections should be kept as near to the above standard measurements as possible but the wider section will occupy any area left after the standard sections have been built. Some large Big Head are

kept in the water-way to clean up the water because Big Head are macroplankton feeders.

The unpartitioned ponds are provided for the rearing of Grass Carp or Mud Carp alone.

(2) *Sieve* (篩)—Sieve measuring 2 ft. diameter 10 ins. deep are made of rounded bamboo splits and are divided into 20 or more grades for the purpose of separating different kinds and sizes of fry. Each grade is named and numbered according to the fineness of the holes provided in the sieves for the fry of certain fish to pass through at certain age. The grade 1 and 1½ sieve, for example, will let only very fine fry of a certain wild Mud Carp pass through, whilst grade No. 2. will separate the fry of Mud Carp from those of the Grass Carp. As the very young fry of the Big Head and Silver Carp are always bigger than those of Grass Carp, sieve No. 2½ is used to isolate the former two from the latter. Older fry will be separated from the young ones with Nos. 3, 4 etc., whichever is appropriate; fry are named according to the grade of sieve through which they pass. Sieves are made by hand; it requires special technique and skill to manufacture good sieves. Only one Pan Yu Lin in Kwang Li and Ka Tze in Shiuhing are recognised as the best makers.

(3) *Ramie cloth troughs* (魚花池)—As the name implies, troughs employed in the course of fry handling are made of ramie or china grass, *Boehmeria nivea*. There are 3 kinds of these troughs; the first is finest in texture and is called *Kwok Chi*, the second *Sam Chai Chi* and the third kind *Tai Chi*.

A. The *Kwok Chi* (綹池) or No. 1 trough, is made of finest ramie cloth and is used to hold the fry belonging to the grades from newly hatched ones to No. 4. The size of this type of trough varies from 40 to 60 ft. long, 25 ins. wide and 20 ins. deep.

B. The *Sam Chai Chi* (三紗池) or No. 3 trough is made of courser ramie cloth for holding fry of grade No. 5 or 6.

C. The *Tai Chi* (大池) or big trough is made of very course ramie cloth for handling fry over 7th grade.

(4) *Dip nets* (魚撇)—Dip nets are used to transfer fry from one container to another. They are also made of ramie cloth with a piece of rattan or bamboo bent to form a ring 1½ to 2 ft. in diameter and with a handle 8—10 ins. long. The net is about 10 ins. deep.

(5) *Big fry sorting basket* (大柲籮)—This basket is used to sort mixed fry. It is made of bamboo splits and rendered waterproof by a thick mixture of glue and cow dung smeared on the inside and dried over a charcoal fire. The basket measures 3—4 ft. at widest diameter and 3ft. 6ins. deep.

(6) *Fish fry dishes and cup* (碟及杯)—The dishes are made of light wood (such as *Bombax*) and painted with white enamel. There are two sizes, the big one measuring 10 ins. diameter, 1¾ ins. deep and the small 8⅞ ins. in diameter and 1½ ins. in depth. The cup is usually made of tin, 3⅛ ins. diameter and one in. in depth. Dishes are very useful tools and units in handling, counting and sorting or fry. Newly hatched fry (or river fry) cannot be counted in the same manner as large ones; they are measured by dishes and cup. A big dish when full contains 400,000 newly hatched fry of Grass Carp, Big Head or Silver Carp and 800,000 of Mud Carp. A small dish contains only half as many. A cup can hold 40,000 Grass Carp, Big Head, or Silver Carp and 80,000 Mud Carp.

(7) *Fry carrying baskets and tubs* (魚籮及桶) Baskets and tubs are used for transportation of fry. The former are made of bamboo-splits to any convenient size for one person to carry a pair easily. The baskets are rendered water-proof in the same way as the fry sorting baskets. To convey fry by means of railway and lorry big baskets are used. Large wooden tubs, 3 or 4 ft. high and 2 or 3 ft. diameter are employed to transport fry on ship, rail or trucks.

(8) *Bamboo mattings* (竹筲)—Nursery ponds are partitioned by this type of matting which is made with broad bamboo splits to measurements about 7½ by 4 ft.

(9) *Bamboo screen* (箔)—Strong bamboo-splits are used to make screens, each piece measuring 17 ft. long and 4 ft. high, for the purpose of fishing fry from the ponds.

WORK IN THE NURSERY

Preparation of the Nursery Ponds—Shortly before the appearance and collection of the newly hatched fry from the river, clean and adequately fertilized nursery ponds must be well prepared and completed. To prepare a good pond, work has to be begun early in December, when the pond may easily be dried up during the winter drought; all kinds of harmful creatures such as Snake-head (*Ophicephalus*), Goby (*Gobius*), River pike (*Elopichthys bambusa*), the Giant bug (*Belostoma deyrollei*), and the water beetle (*Cybister*) must be destroyed with lime and tea-seed cakes. A week after this clean-up

action the pond is re-filled with clean and screened water to a depth of 2 or 3 ft. and then to every mow (1/5 acre) of pond 3 piculs of goat weeds, *Ageratum conzoides* Linn., and *Siegesbeckia orientalis* Linn. and some cow dung are added. These plants are left near the bunds and the cow dung is distributed equally over the pond; they decay and the water becomes brownish green in colour. The pond is then ready to receive the fry. Three days after fry are introduced to a pond with Big Head and Silver Carp, 200 catties (260 lbs.) of goat weed should be added once every three days; to a pond with Mud Carp 260 lbs. of cow dung per mow (1/5 acre) once every day and to a pond with Grass Carp 260 lbs. of goat-weed and cow dung once every 4 days.

Procedure of Fry Sorting—The work of sorting and rearing the newly hatched fry may well be discussed and explained by describing an actual operation. One morning, for example, the fishermen at the collecting stations bring 100 dishes of 40,000,000 fry to the nursery from the river. The fry expert sets to work immediately to ascertain the percentages of various types of fry as close as possible. He takes at random a small sample from the big lot and brings it to his simply equipped laboratory to sort out the different kinds of fry, each to be placed in a bowl containing clear water. When the number of fry in each bowl has been counted the percentage of each kind is calculated.

Now suppose through the expert's assay we come to know that from the 100 dishes we should have 10% Big Head and Silver Carp, 40% Mud Carp, and 20% Grass Carp. The rest are miscellaneous fry. In case there are no customers to buy the "river fry" immediately the following work on sorting and rearing must be started without delay. The river fry are poured together into a big ramie trough (Tai Kwok Chi) which has been spread and suspended on small bamboo sticks erected in a big fish pond with 2/3 submerged in water. Any dead fry and dirt are removed with the help of a dish and hand. Next the fry of *Elopichthys, Siniperca* and other undesirable species are sieved out and got rid of by No. 2½ or 3 sieves. On account of the fact that most undesirable fishes are bigger than the domesticated ones, the No. 3 sieve will virtually let the latter pass through and retain the former in the sieve.

Forty to fifty dishes of the good fry left in the trough are transferred to a big sorting basket about half full of water. Waiting for 10 minutes and watching carefully for numerous tiny brilliant and sparkling specks of eyes to appear on the surface of water in the basket, the expert then quickly splashes water from the pond over the fish in the basket with the help of a dish. In half a minute the various kinds of fry will group themselves into upper, middle and lower layers. The very fine *Elopichthys* and other miscellaneous fish usually occupy the upper-most layer, the Big Head and Silver Carp on the upper layer, the Grass Carp on the middle layer, and the Mud Carp and Wild Mud Carp in the lower layer. Taking advantage of this self-separating habit of the various fry under the special conditions, the expert uses simply a dish to skim off and destroy the undesirable fish which are in the upper-most layer. He must remember, however, to splash appropriate quantities of water into the basket on the side or at the middle at proper intervals in order to supply some oxygen to the fish; steps must be followed as quickly as possible, otherwise the fry die from suffocation and cease to be segregated. In the same manner the Big Head and the Silver Carp in the lower are removed and put in different sections of the trough for further treatment.

The remaining mixed fry in the trough are treated in the same manner. This work should be completed in about an hour.

Although there are no scientific data available at present, the under-lying principle of the above phenomena and practice of fry sorting may be ascribed to the fact that the oxygen requirement of fry and the capability of maintaining normal respiration in oxygen-deficient water, varies to a great extent from species to species. The Silver Carp are most active and need more dissolved oxygen. They always come to the surface when the air content of the water or the pond is low in the morning and evening. The Big Head requires comparatively less oxygen so they remain in the sub-surface. The Grass Carp requires still less and the Mud Carp the least, so they stay in the middle and lower layers respectively.

Separation of Silver Carp from Big Head—Thus from the 100 dishes containing 40,000,000 fry as estimated, 4,000,000 Big Head and Silver Carp are sorted out and retained in 2 small sections of the partitioned pond in the morning. At about 4.30 p.m. on the same day when most of the Silver Carp will come to the surface of the water probably in search of more oxygen and food, while the Big Head remain in the lower layer, a fine netting is used to drag along the surface of the water keeping only about 2 inches deep; in this way it is possible to remove part of the Silver Carp from the Big Head. The Silver Carp singled out in this manner are then placed in an empty small section of the pond. The remaining mixed fry in the 2 small sections are again fished out as completely as possible

and retained in a long section on the same evening. This operation is known as "first sorting".

Next morning at 10.30 a.m. "second sorting" is to be carried out. The first catch from skimming 2 inches deep in the water with a net consists practically of pure Silver Carp; second catch from fishing at 6 inches deep consists of both Silver Carp and Big Head, half and half (this is called the mixture) and the remainder in the pond is composed solely of Big Head. The pure lots of Silver Carp and Big Head are retained separately in the long or wide sections and the mixture in wider sections of the pond. Four days afterward as the fish become bigger, they are fished and removed to other wider sections or any bigger unpartitioned ponds for further rearing.

The Grass Carp from the middle layer in the sorting basket are released in the unpartitioned pond or ponds. Eight Million Grass Carp fry should be placed in four 6-mow (1 1/5 acre) ponds (20% of 40,000,000 "river fry"). The sixteen million Mud Carp fry from the 40 million should be put in four 6-mow (1 1/5 acre) ponds for temporary rearing.

TRANSPORTATION OF FISH FRY

Fish fry are extremely delicate creatures and their transportation requires special skill and technique. There are three practical methods of conveying fish fry from one country to another; (1) Land and sea Transportation; (2) River Transportation; (3) Air Transportation.

Land and Sea Transportation—On land fish fry ranging from tiny newly hatched larval forms to several inches in length are conveyed from one place to another in different types of baskets made of bamboo-splits or wood. One man can carry on his shoulder 2 baskets each holding about 30 to 40 lbs. of water containing 2,000 to 3,000 fry 1 inch in length. Of course more fry will be carried if they are smaller.

In carrying the fry the man must walk quickly to produce such motions as to effect proper shaking of the baskets and of the water in them. The shaking of the water will probably facilitate elimination of carbon dioxide from the water and absorption of oxygen from air.

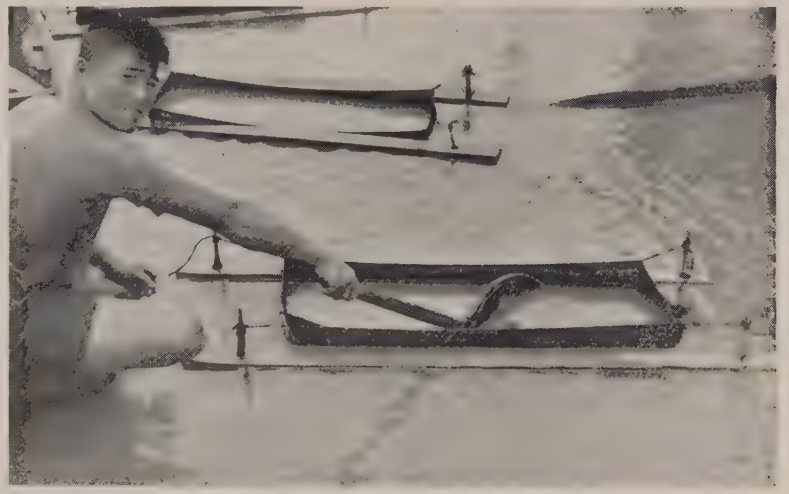
Where fry have to be carried over a long distance requiring several days or weeks of walk the carriers have to select some intermediate stops. In a station for intermediate stop which usually extends from evening to early next morning the fry are liberated into a ramie trough suspended on bamboo sticks over a pond, and they are fed with a mixture of yolk of egg and flour smeared over a small rectangular piece of wood with the smeared surface overhanging in water. The fry will come frequently to snip the food whenever they are hungry. In many cases like those in which fry are transported from Hankow to Wan Hsien in Szechuan and big quantities of fry are transported from Hong Kong to Siam and Singapore the fry are fed with cooked yolk of eggs or soya bean. The well-cooked yolk of egg or soya bean are ground into a very fine paste in a stone mill. The fry are fed by mixing some of this fine paste in the trough, watching carefully that most of the suspended particles of the paste are eaten up by the fish.

Fish fry are transported over long distance by rail, ships or lorries. Big baskets or wooden tubs of various sizes (the biggest measuring 7 ft. high, 6.5. in bottom diameter) are placed on board a ship or rail and in one of them 50,000 fish of 8½ grade, 1½" to 2" in length are put with the tub half full of water. Fry smaller than 1½" in length are not hardy enough to survive long travel. The surface of water is kept in motion all the time (day and night) during transportation. A few minutes or even seconds negligence by a fatigued worker leaving the paddle idle, will cause complete mortality of the fry. Filthy water from the container is bailed out continuously in small quantities and new fresh water added whenever possible. In river transportation where fresh water supply is plenty, there is no difficulty but in sea transportation, fresh water is scanty and since the supply diminishes whilst the journey is in progress the workers must exercise strict economy in water changing and pay great attention to the job. Three to four such big tubs, holding a total of 150,000 to 200,000 fish fry, are placed on board ships sailing from Swatow or Hong Kong to Singapore, and 4 to 6 experienced workmen are engaged to look after the fish. Mortality of fish on such trip depends a great deal on weather conditions and on the length of the journey. If the weather is good enough to permit the workers to work regularly and if the journey should last less than 6 or 7 days, 60% survival may be expected.

River Transport—There are two means of river transportation namely, first, fish fry in baskets which are put on board a vessel as described above, and secondly fish fry are put in live holds with a few or many holes to permit water coming in and out freely. The arrangement of the live holds can be classified into 2 different types. To the first type belong those holds with many holes on the bottom of the boat, which can be closed with stoppers when-

1. The rectangular end nets suspended on and being kept afloat by a frame of China fir and the central long floats of the bag nets are clearly shown in the photograph.

2. Farmeworks built on the slope of the river bank, on which bag nets are hung to collect fry when the water of the river rises. The end nets are seen as small, dark, oblong figures on the water surface, behind which are the tail-like streaks on the China fir floats to keep the bags from sinking.

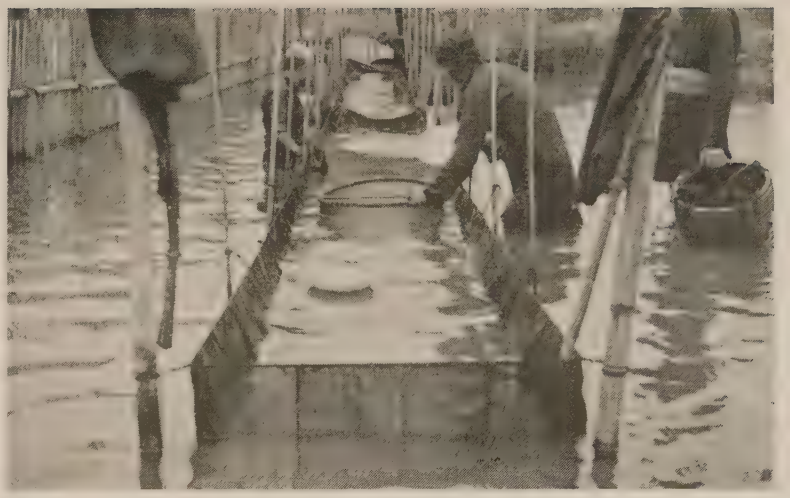


3. A fisherman collects fish fry from the end net.

4. A ramie-cloth trough spread and hung on bamboo sticks in a pond with required sections made to serve as temporary storage of fry during sorting.

PLATE III. FISH FRY INDUSTRY OF CHINA.

1. A typical pattern of a partitioned pond, by which bamboo-matting is used to divide a pond into sections of various size for rearing and separation of different kinds of "river fry".



2. Several experts are busy in sorting out the various fry from the big basket.

3. A big fry sorting basket which can also be used for fry transportation.

4. A small bamboo basket for carrying fish fry.

PLATE IV. FISH FRY INDUSTRY OF CHINA.

ever desired. A boat about 24 ft. long is provided with 4 such many-holed compartments each of which can hold 1,000,000 to 1,500,000 river fry. The walls of the hold are carefully screened with fine ramie cloth to prevent the fry from escaping.

In a hold of the second type only 3 holes are cut in the bottom of the boat; into each hole a short pipe is fitted to let water in. The upper end of this pipe is fitted with a piece of short bamboo piping with a few holes to give a good spray of water over the compartment. The tip of the pipe is placed below the surface of the river outside the boat so as to give a fountain under hydraulic pressure which can be increased or decreased by varying the level of the pipe. A boat with this fountain type of holds is divided into 6 or 7 compartments, communicating with one another by openings cut on the bulkheads between them. These openings are screened with ramie cloth to prevent mingling of the fry. The middle compartment or hold into which water from all holds can come in, is reserved for a water wheel to pump water out in order to keep all the holds in good circulation of water. This type of boat with six compartments can hold 10,000,000 river fry.

Air Transport—For air transportation fish fry are picked in hermetically sealed containers (usually tin cans 9″ x 9″ x 14″) with oxygen and water. The voyage from Hong Kong to Singapore, takes several days by sea but only a few hours by air. As experiments have shown that considerable quantity of fish fry can be packed with oxygen under slight pressure in sealed tins and last over 20 hours with safety, the possibility of air transportation is quite real.

By a series of painstaking experiments, it has now become a practical means of fry transportation on commercial scale.

The idea of supplying oxygen to fish in aquarium is an old one and many experiments on packing fish with oxygen and water in sealed containers had been carried out by scientists over the world. Birtwistle reports the use of a method described in Document No. 1045 published by U.S. Bureau of Fisheries by which he experimented on common Carp and Silver Carp transport with excellent results. His fish survived packing of 26 to 30 hours.

In 1947 when C. F. Hickling, Fisheries Adviser to the Secretary of State for the Colonies visited Hong Kong, a trip was made with me to the West River to see the fish fry industry and pond culture. He mentioned the possibility of sending Carp to Singapore in oxygenated tins by air. Later in the same year the Fisheries Department of Singapore suggested to the Hong Kong Fisheries Research Station to carry out some trial shipment by "Skyways" planes. The first experimental shipment of 2 tins containing 1,213 fry made in July 1947 was a failure due to some technical defect. The second shipment of 600 fish in tins in the same month proved a success. Following this, the Hong Kong Fisheries Research Station has made 40 shipments of 157,737 fry by air to Singapore and Bangkok up to the end of November 1948.

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2

OCEANOGRAPHY IN THE INDONESIAN ARCHIPELAGO

by Cdr. M. W. R. Krauss

For the first investigations on physical and chemical oceanography in the Indonesian Archipelago, we have to go back to the years 1872—76, when the British Explorer "CHALLENGER" made her famous cruise around the world. Many cruises conducted by several nations followed, but all these expeditions had the same aim: exploitation of all means of oceanographic and biological interest, from a purely scientific point of view.

The establishment of the "VISSCHERIJ STATION" (Fisheries Station) at Batavia, in the year 1905, was the first step in real activity in oceanographic survey. The aim of this institution was: Investigation of problems of the Indonesian waters from a scientific as well as from a practical point of view.

With the Government steamvessel "GIER", many extensive cruises were made to try out the possibilities of trawling in Indonesian waters. In 1914 Capt K. M. van Weel started his first systematic survey of the Java Sea. During this survey special notice was taken of salinities, densities and temperatures, the horizontal and vertical distributions of these properties and their seasonal changes. The plotted results of these investigations are on file but the data are lost. This survey was ended in August 1915.

This first oceanographic survey was followed up by an extensive survey during 1917—20, covering the areas of the Java Sea, South China Sea, and Malacca Straits. This survey again was conducted by Capt. K. M. van Weel, who published his results in "Treubia" May 1923 "Meteorological and Hydrographical Observations, made in the Western part of the Netherland East Indian Archipelago." Many charts showing the distributions of salinities, densities and temperatures accompany this publication.

A full interpretation of the results of Capt van Weel's survey was published by Dr. H. P. Berlage Jr., in 1927 "Monsoon-currents in the Java Sea and its entrance".

From 1920 oceanographic work came nearly to a standstill, but in 1939 a new start was made. A ship was made available by the fisheries department for oceanographic work and was run for the Laboratory.

Under Capt Veen 4 cruises were made yearly covering Sunda Straits and the Java Sea up to the 200 meter line in the Macassar Straits. These cruises were made during the West and East Moonsoon and during the two changes. Water samples were taken from surface to bottom, currents measured, temperatures noted, transparency measured with Secchi disc, etc.

Water samples were analyzed at the Laboratory at Batavia for salinity. With the cooperation of the Koninklijke Paketvaart Maatschappij surface water samples also were taken on board ships running on regular lines crossing the Java Sea, Sunda Straits or Macassar Straits. Also many lighthouse-keepers collected weekly watersamples.

Dr. L. Van Dam entered the Laboratory as oceanographer and worked out a method of microchlorine titration, which is described in "TREUBIA" Nr 17, Dec 1940 "Estimation of Chloride in 1 cc seawater sample by means of syringe pipettes."

This method saved us lots of trouble during wartime, when silver nitrate was very scarce and costly.

The activities of the Laboratory came to a sudden end with the outbreak of war with Japan in December 1941. Not before July 1947 the Laboratory came in our hands again, but it took a long time to arrange and tidy the mess that was left over from the time of occupation and turmoil. Very fortunately we found all oceanographic data back and complete. These data will be worked up as soon as possible.

Activities in the Laboratory are in full swing again. Thanks to the cooperation of the Koninklijke Paketvaart Maatschappij and their Captains and officers surface samples and temperatures are collected on about 30 ships running on regular lines from Medan to Hollandia and Merauke. We also mention the cooperation of the Department of Shipping and Navigation and their Lighthouse-keepers, who weekly collect surface samples on about 30 offlying lighthouses.

Rehabilitation of the Laboratory is nicely under way, orders for equipment, chemicals and glassware have been placed.

A seagoing launch of about 40 feet is on the way to completion and most probably will be delivered in April.

In collaboration with the Fisheries Department plans are worked out for a seasonal investigation of the seas lying around North Celebes and Gilolo (Halmaheira) for which survey the Fisheries Department will try to make available a ship as soon as possible.

Plans for a new research vessel are worked out and under consideration.

3

MARINE FISHERIES OF INDIA

RESOURCE

The chief source of collated information regarding the Fisheries of India is the official publication of the Government of India, Ministry of Agriculture entitled the "Report on the Marketing of Fish in India" (Manager of Publications, Delhi, 1946). This is a compilation of the Marketing Department (of the Government of India, Ministry of Agriculture) which collected information from various sources including a large number of fishermen, fish-curers, merchants and fishery officials and others. It will be seen that this compilation reveals that no real scientific effort had been made hitherto in Indian waters to estimate effectively the extent of bottom or pelagic fisheries with the help of suitable craft, more particularly the small deep-sea fishing boats, danish seines, long lines, etc. suited for fishing in sub-surface or mid-waters which may be expected to yield commercially adequate catches of prime and other fish. Trawling experiments in the Bay of Bengal, the Arabian sea and the Gulf of Manaar have revealed that the catches consisted of a large proportion of Elasmobranchs and Percomorphid genera some of which can be classed only as bottom-feeders. Such statistics as have been collected by the Marketing Department reveal that herrings and anchovies, mackerel and perches, and prawns, all pelagic fishes—hold the first three places in the pelagic fisheries of India followed by a group of miscellaneous mid-water fish including jew-fish, silver bellies, Bombay duck, Pomfrets, Indian salmon, mullets, and silver-bar. The fact that some or all of these pelagic forms and the bottom-feeding sharks and rays, cat-fishes, and soles have been obtained in the course of the trawling experiments reveal that there is a certain degree of intermingling of the so-called bottom and pelagic fishes in Indian waters. As far as one can judge from the craft and gear employed hitherto to exploit fishery resources in our waters, it would appear that the exploitation of the resources, particularly in reference to the pelagic fisheries, has neither been on the right lines nor adequate.

ENVIRONMENT

The estimated annual production figures of seafish on our coast (11,666,000 mds. or 933,280,000 lbs.) for an exploitable area of 115,000 sq. miles (100 mds. or 8,000 lbs. per sq. mile) may be unimpressive when compared to the production figures of other countries of much smaller size, but the geograpraphical and meteorological features of the country and what little is known of the oceanography of the Bay of Bengal, the Indian Ocean and the Arabian sea suggest that the environment for fisheries in the coastal belt up to the 100 fathom lines is likely to be favourable. If improved methods of estimation were adopted on a much larger scale than has hitherto been possible and the existing fishing craft were mechanised, making it possible to use larger and improved fishing gear in a wider range of environment, it seems likely that our fishable waters would show themselves to be more prolific and capable of being exploited all the year round to provide an unfailing source of supplementary food to the majority of our population who would eat it, if available and within the range of their income.

The chief agents of exploitation on our coasts are the fishing communities whose socio-economic status, being much below that of even our agricultural communities, would need to be raised considerably by governmental and other agencies before the exploitation process can be quickened. Estimation of resources will be greatly assisted by helping to raise their socio-economic status. There is, however, scope for undertaking the estimation by other means such as summoning the aid of the Navy, the Merchant Fleet, and employing specially fitted research vessels as in some S. East Asia countries.

METHODS OF INVESTIGATION

In view of the almost total absence of well-equipped and modern Marine Biological Laboratories along the Indian Coasts to study the biology of fish and the physical environment in which they live, it was found necessary by the Government of India to establish as part of their fishery development programme a Marine Fisheries Research station on the S. East Coast of India with three sub-stations on the W. Coast to study the biology of the more important species of commercial fish common on the two coasts. The main station, now temporarily located in the University Biological Laboratories, Madras, will be more or less permanently housed in the altered and renovated Naval hospital buildings at Mandapam (S.I.Rly.) on the Gulf of Manaar as soon as they are ready for occupation in a few months. Within a radius of a hundred miles from this station exist different types of sea and backwater fisheries which include a large variety of pelagic, reef-dwelling and bottom fishes. Harbour facilities for vessels with a draft of up to 10 feet

are available during the S.W. and N.E. monsoons in the vicinity of Mandapam on either side of the Pamban causeway which divides Palk Bay from the Gulf of Manaar. The Central Fisheries Research Station is situated within a mile from the Mandapam Camp station of the S. Indian Rly. main line connecting Madras with Colombo. There is a considerable indigenous fishing population, with traditional fishing craft and gear, scattered in coastal villages south and north of Mandapam, some of them served by second class roads. The Fisheries station will consist of several sections dealing with the chemistry of sea-water, physiology of fishes, marine biology including bacteriology, fishery biology, and fishery training. Separate laboratories are being provided for each of these. A rowing boat and a small paraffin-engined 22 ft. motor boat for inshore work will form part of the equipment. A separate aquarium with 14 small and 6 big tanks for observation, with running sea and fresh water is being built. The Physiology room is being air-conditioned and provided with a vibration-proof room for experimental work. A dark room for photography, a library and a small museum are also being provided in the existing buildings. Temporary residential accommodation will be provided for the staff in the buildings until permanent quarters are constructed. Until electric power from the Pykara mains becomes available, a separate generating set is being provided for the station. A supply of freshwater from the Ceylon Government Quarantine Camp is expected to be available by the time the Station buildings are ready for occupation.

As the sardines, anchovies, mackerel and perches constitute the major part of the pelagic fish production on our coasts, more particularly on the west coast where totally different geographical and meteorological conditions prevail, three sub-stations have been established at Bombay, Calicut and Karwar, separated from one another by a distance of about 300 miles. Bombay is the headquarters of the Fishery Survey Section in charge of the Fishery Officer, who is assisted by a Statistical Officer and Fish Taxonomist. The work of the survey section relates to a more detailed estimation of our fishery resources than has hitherto been possible at representative centres along the east and west coasts of the Indian Union territory. The entire Indian coastal area is divided into twelve somewhat unequal zones, each in charge of a trained graduate survey assistant conversant with the local languages and fishery conditions.

Each assistant is required to visit the more important fishing centres in his zone every month and record information on (1) qualitative and quantitative composition of the catches of a single fishing unit, (2) number of men, craft and gear employed and the duration of effort, (3) distance from shore and depth, (4) meteorological conditions, (5) ranges of size and weight of fish, (6) proportion of sexes and sexual maturity, and (7) and other biological facts. These data collected over a period of one year may be expected to provide on statistical analysis a reliable guide to the estimation of our fishery resources. It is considered essential that information should be obtained from our navy and merchant vessels regarding the movements of shoals of fish in off-shore waters and high seas, and the currents and meteorological conditions. They could also be requested to obtain and preserve samples of sea water, plankton and fish to serve as a guide to the movements of shoals of fish. In the absence of a well-equipped sea-going research vessel in Indian waters, the data collected by the navy and the merchant fleet would be of the utmost value. The mackerel fishery on the west coast has been seasonal between Mangalore and Ratnagiri, and large catches are obtained between October and February and cured in various ways for export to the interior and to Ceylon or sold fresh preserved in ice in the Bombay market. There are at present no reliable data of any kind regarding the widespread movements of the enormous shoals of mackerel on the west coast and the whereabouts of these shoals in the off-season. Work relating to the biology of mackerel has been taken up by the Fishery Biology section both at the Calicut and the Karwar substations where investigating staff have been stationed. The food, growth, sexual maturity and age of mackerel are at present being studied, but until extensive tagging experiments are undertaken the clue to the movements of mackerel cannot be obtained. The restricted nature of fishing for mackerel in inshore waters, the lack of fast fishing or other craft to follow shoals when sighted, and the ignorance of fishermen who have to be educated to understand the significance of scientific experiments and observation preclude the possibility of studying migrations of mackerel by tagging methods in the near future. Nevertheless, an early attempt will be made to commence tagging experiments of some of the shoaling species. When fast mechanised fishing craft are available on the west coast, the following and catching of shoals of sardines will perhaps be rendered easy. Its sporadic appearance in small numbers in inshore waters and rarely in bigger shoals is almost a certain indication that the revival of the sardine fishery will be a distinct possibility with the increase in the number of mechanised fishing craft and the wide range of concerted fishing operations. Growth and maturity of the oil-sardines are at present being studied at Calicut.

The status of the fisheries for prime fish which have a large consumers' demand in all metropolitan

markets is at present not clearly known. Reports of the occurrence of shoals of Bonito (*Thynnus*), Barracuda (*Sphyraena*), Seer (*Cybium*), Indian salmon (*Polynemus*), Pomfrets (*Stromateus*), Jew-fish (*Sciaena*), in Indian waters are often received from sailors, but no true estimate of these reports can be formed without proper verification of records in regularly maintained log books of ships. Until large mechanised fishing craft begin to operate in off-shore regions with suitable gear and tackle, the volume of such records cannot be expected to increase and form the basis for future plans of exploitation.

In addition to the prime fish mentioned above, shoals of varying sizes of the following species have been known to occur on our coasts in in-shore and deep sea regions off the mainland and the Andaman and Nicobar groups of islands:—

Whiting (*Sillago*), silver-bellies (*Equula, Gerres, Gazza*), Ribbon fish (*Trichiurus*), Gar-fish (*Belone* & *Hemirhamphus*), silver-bar (*Chirocentrus*), flying fish (*Cypsilurus*), flat-fishes (*Cynoglossus, Psettodes, Plagusia,* & *Pseudorhombus*), mullets (*Mugil*), Bombay ducks (*Harpodon*), prawns (*Penaeus, Metapenaeus, Leander*), lobsters (*Scyllarus* & *Thenus*).

Sharks, saw-fish, skates, rays, eels and catfishes also constitute an important part of our commercial fisheries on our coasts. Some of these are used as food by the poorer classes of people, but there is ample scope for better utilisation of the by-products of these fisheries.

The scope of shell-fisheries on the mainland of India in the island territories of the Andamans and Nicobars and the Laccadives is vast, but a judicious exploitation of these resources can be based only on fuller information being available on the biology of these fish.

The following concise report on the biological, hydrological, physiological, and survey work of the Marine Fisheries Research station will serve to give a bird's eye view of the activities of the station.

CENTRAL MARINE FISHERIES RESEARCH STATION, MADRAS.

FISHERY BIOLOGY

(a) Fish: The chief activities of this section are being conducted at the main and the three sub-stations at Calicut, Karwar and Bombay. The work at the main station centres round marine biology in addition to the biology of sharks and rays, ribbon fish, prawns and crabs, oysters and clams, and seaweeds, and at Calicut round herrings (sardines and anchovies) and mackerel and other fish of lesser economic importance (cat-fish, Indian salmon, perches, jew-fish and flat fish) and the plankton (zoo- and phyto-) on which they feed, at Karwar round mackerel and at Bombay round Bombay-duck.

INVESTIGATIONS AT CALICUT:

Apart from periodical exmination of commercial catches in Calicut and the other chief fishing centres along the Malabar coast, fish and plankton collections are made on alternate days, at Calicut by the departmental fieldmen to maintain a systematic record of catches with a view to determine the relative abundance of various species and size at maturity. These records as well as those maintained by the Madras Fisheries Department show that practically all species of food fishes have more or less definite peak periods of occurrence in coastal waters. When species occur in great abundance and our own catches are good all the specimens are sorted, measured and weighed and recorded in a fish register maintained for the purpose. They are systematically examined for stomach contents, gonads and parasites and the results entered in the register. A quantitative analysis of food organisms is also being undertaken to correlate it with the relative abundance of such organisms in plankton collections. A more precise appraisal of the conditions of the gonads based on the method of maturity scales adopted by the International Council for the exploitation of the Sea is being undertaken.

The well-known method of determining growth in fishes by certain ring markings in the scales and otoliths of various temperate species of commercial fish is being tested in the case of our species. Periodic rings (1—2, rarely three) have been noticed so far only in the oil sardine (*Sardinella longiceps*). In addition, variations in fin formula, body proportions, stomach contents, sexes, gonad condition of the four species of sardines common on the West coast are being recorded.

A systematic record of the occurrence of different types of fish eggs and larvae found in the plankton is being maintained. Eggs of the sardines (*S. longiceps* & *Kowala thoracata*), the anchovy (*Stolephorus tri*) and the horse mackerel have so far been identified, and all relevant details regarding time, place, weather, currents, etc. with reference to these are being recorded.

SARDINES: In August and September, readily extrusible transparent eggs were found in mature oil-sardines. A large shoal of oil-sardines was seen early in December off Calicut and 384 specimens

were collected. Oil sardine eggs collected from the plankton were reared in the laboratory till the larval development up to the complete absorption of the yolk had been followed. The development of the white sardine egg is also being investigated on the same line.

MACKEREL: At Karwar, mackerel had been obtained only rarely in the monsoon season. In June and July 1948 a few large gravid females (20-25 fms.) were observed. No mackerel were recorded in August while in September they were caught frequently in mixed shoals with *Clupea fimbriata*. From September onwards specimens 10-15 cms. long were caught daily in small numbers. Occasionally larger sizes up to 20 cms. were being sold in the fish market. From October onwards shoals of mackerel (14-16 cms.) were quite common in the Karwar Bay, but in November larger mackerel ranging from 16-18 cms. were seen in commercial catches. Diatoms and copepods, and occasionally sand grains and fish scales (showing that it is occasionally a bottom feeder as well) have been seen in the stomach contents.

Advantage of the occurrence of large numbers of mackerel in the season has been taken to initiate racial studies based on skeletal and external characters. This is being pursued as a side-line study on holidays with a view to elaborating it when the results show any promise of being used for distinction of races.

SHARKS & RAYS: The occurrence, distribution, seasonal abundance, general habits such as migration, shoaling and constitution of shoals, breeding season, sexual maturity, early life-history were studied in the more important shark-fishing centres of the S. East coast of Madras presidency, between Tuticorin and Dhanushkodi, and the latter and Adhirampatnam. Records of the nature of the bottom, depth of the sea and distances from shore, the season of occurrence, the craft and gear used in catching various species, the number of species and individuals of both sexes of each species, condition of gonads and of uteri and claspers, measurements of individuals, external and internal parasites are being maintained. Species of *Scoliodon, Carcharias, Sphyrna, Pristis, Myliobatis, Rhinoptera* and *Trygon* constitute the heaviest catches of off-shore fishing in all the centres of fishing. Shoals of sharks, rays and skates are usually unispecific, unisexual, and unidimensional and this is noticeable more particularly in boats bringing unispecific shoals. This kind of grouping is at times too pronounced to be explained as the result of chance. Excess of males over females was noted in some species. When the entire uterine contents of single specimens are examined, the embroys of both sexes are found in more or less equal numbers. The segregation of sex according to size seems to take place after birth. This is an interesting phenomenon which requires further study. Embryological and developmental studies in *Scoliodon walbeehmi*, observations on the gestation of *Trygon uarnak, Hypolophus sephen*, and *Pteroplatea micrura* have been made.

RIBBON-FISHES: Since among the three species of *Trichiurus* occurring in Indian waters, *T. haumela* appears to be the most common, the biological observations made on ribbon fishes refer to this species. The feeding and breeding habits have been studied. These habits reveal that the species feeds on different species of the smaller forms of fish including its own kind, prawns and cuttle fishes and that the feeding activity as judged from the quantitative study of its stomach contents is highest from July up to February and that this period coincides with the spent condition of the gonads. From March to June when the shoals move off shore, the choice of food seems to be restricted to the smaller species of fish such as *Stolephorus, Equula, Gazza* and of the prawn *Acetes*.

Maturity seems to be attained when the ribbon-fish of both sexes reach a size of 47 — 48 cms. in length. The wide range of data collected on the size of individuals and of their gonads has enabled the classification of the stages of maturity—not into the seven stages of maturity of the International Council for Exploration of the Sea—but into 5 stages, as the process of maturation starts only when the fish grow to a size of 47—48 cms. Stages III—V. of I.C.E.S. appear to be compressed in the present stage 3, which may be designated "mature". The spawning condition (Stage IV of the I.C.E.S.) has not yet been observed. The mature egg is 1.1 mm. in diam. and is found only in individuals 48 cms. long.

From the fact that ribbon fish do not appear in general catches from March to June, but begin to appear with spent gonads from July onwards it may be inferred that shoals move away from coastal to deeper waters for spawning and come back to shallow coastal waters for feeding.

The study of the duration of the spawning period by measurements of the intra-ovarian eggs by Hickling & Ruttenbergh's method has been continued.

(b) Shell Fishery:

(1). Crustacea.

PRAWNS & CRABS: *Penaeus indicus* in Puli at Lake provides a stakenet fishery throughout the year

except when rains fail and the connection with the sea is cut off temporarily. In Ennore and Adyar the bar remains closed for the major part of the year. Influx of young forms (26 — 30 mm.) into the Lake in August, October and November after the rains was observed. They generally congregate in shallow regions where algal growth is abundant. Breeding presumably takes place in July and Sept. and post larval forms migrate into the lake from the sea. Fishermen assert that prawn-fishing in April and June at the mouth of the bar during low tides is highly productive yielding boat loads of prawns in a few hours—suggesting mass-migration into the sea from the lake presumably for purposes of breeding. Harpacticid copepods and bottom debris of sand and vegetable matter form the main constituents of food of the prawns, suggesting their bottom-feeding habit. They do not seem to breed in the backwater judging from the study of the gonads which are never mature.

In Ennore prawns do not occur from July to October when with the commencement of the monsoon showers and lowering of salinity a sudden influx of large numbers of big-sized prawns takes place.

In Adyar—*P. indicus* and *M. Monoceros* alternate in abundance in the months of March and August and in April respectively. In October with the opening of the bar there is an influx of young prawns of 31 — 35 mm.

In Ernakulam—*M. dobsoni* predominates in November.

Larval development of the common Penaeids of Madras: Pre-mysis and post-mysis stages are never available in appreciable numbers. Larval and early post-larval stages of *P. indicus, P. carinatus, M. monoceros, dobsoni, brevicornis* and *Trachypenaeus* were studied. Colour has proved a reliable criterion for distinguishing *Metapenaeus* sp. It has been possible to study the early rate of growth of prawns in all the stages for a period between 6 to 13 weeks—which makes it possible to estimate roughly the age of smaller prawns in commercial catches.

The last phyllosoma stage of 2 species of lobsters—*Thenus orientalis* and *Scyllarus* and the megalopae of *Macrophthalmus, Charybdes* and *Thalamita* have also been reared to the stages at which identification is certain. The rate of growth of *Neptunus pelagicus* from its megalopa stage was observed to be rapid under laboratory conditions in a period of 8 weeks.

Biology of *M. dobsoni*. Material collected from the Cochin backwaters in November showed that they were 13—14 weeks old and probably hatched in August. They seem to appear suddenly in large numbers in the backwaters when they are 20—25 mm. long. It is possible that they migrate from the sea when they are of this size or even smaller. Whether the larger forms in the backwaters are actually migrants from the sea or have grown to this size in the backwaters has yet to be ascertained. No mature female has yet been obtained from brackish water. It probably matures only in the sea. The male seems, however, to differ in that fully developed spermatophores have been found in specimens of 55—70 mm.

(2) Mollusca—Oysters & Clams.

CLAMS (*Meretrix casta*): Growth, life-history, feeding habits and food value of this clam were studied. Growth was studied by (1) measuring marked clams periodically; (2) measuring population samples in definite marked areas; (3) rearing clams under laboratory conditions. For want of circulating water, the last named experiment in growth proved a failure and no growth was registered even after six months. The results of 1 and 2 show that *M. casta* has a very high rate of growth in the younger forms—15 mm., 7 mm., and 5 mm., in the 1st, 2nd and 3rd months, and thereafter growth diminishes rapidly till the 32 mm. stage and becomes static at the 48 mm. stage. The differences in growth in length and breadth persist till the 48 mm. stage is reached when growth is equal. The rates of growth seem to vary with localities subject to rate of flow of currents of water. Salinity seems to have little influence on growth.

The rate of survival of clams based on incidence of sexual maturity and the seasonal changes in the gonadial follicles was studied. The size of clam in which sexual products are first seen is 9 mm. in length, but maturity is not reached till 15 mm. size is attained when it is about a month old. This phenomenon of very early maturity in life coupled with a very rapid growth in younger stages is the main reason which enables the clams to survive at Adyar in spite of intensive fishing in the area.

Veligers reared under laboratory conditions settle down in about 40 hours and the larval stage is short.

The feeding by ciliary mechanism is elaborate and complicated and the course of the food particles from the time they enter the inhalent siphon to the intestine has been determined. The food takes less than three hours to pass through the entire alimentary canal.

Chemical analyses of these clams show that they are as good as oyster in their food value having a fairly high glycogen content of 7.92.

The immense clam resources of Cochin backwaters are subject to serious mortality consequent on the sudden lowering of salinity by monsoon rains. This is preventible when regular farming methods are adopted by regulating flow of fresh water into the clam beds.

OYSTERS: The spawning, early development and growth of spat of the backwater oyster (*Ostrea madrasensis*) are being studied in Pulicat, Ennore backwaters and in the Laboratory both from adult and larval oysters.

Spawning was observed to occur twice a year in March and April and again in November and December and the first stimulus to collective and simultaneous spawning in any given locality is usually given by a single individual. Artificial stimulation for spawning has been successful only in the months in which there was natural spawning, i.e. in March and April and in November and December. The gonadial condition of oysters in different seasons was studied from microscopic examination of serial sections. The cycle has been noted as follows: fully or partially spent in March and first half of April; spent in the latter part of April and May; in a stage of recovery from June to September; full in September, October and partially spent in the latter part of November and in December. The salinity range for spawning in backwaters has been determined to be between 20 and 25 parts per mille and the temperature between 26.0°C. and 27.5°C. The early development of the oyster has been traced under laboratory conditions from the segmenting egg to early shelled veliger, the period of development ranging from 24 hours in summer to 46 hours in December* Larvae of the same species of oyster were collected from the Madras Harbour throughout the year with peaks of occurrence in April, October and November showing that under higher salinity conditions of the sea breeding trends to be more or less continuous. The stages from free-swimming late oyster larvae to spat has been attempted for the first time. An oyster reared from the larval stage is now 4 months old and 15 x 13.7 mm. in size and has been fed upon a suspension of clam meat with a trace of calcium phosphate. After fixation of the larva, growth is rapid up to 6 mm., beyond which it slows down. Experiments on the relative merits of various types of spat-collectors have not been successful in the Adyar backwater and in the harbour owing to the place selected for experiments being unsuitable.

PARASITOLOGY

Systematic examination of fish for Protozoa, Platyhelminths and Crustacean parasites has been made. The largest numbers of infections are of Trematodes (98%), Nematoda and Protozoa (70%), Cestodes approximately (44%) and Copepoda (27%). A new genus of *Opisthocotylea* has been found, *Gastrocotyloides indica* gen. *et.* sp. nov.

MARINE BIOLOGY

The standardisation of field collections, analyses of sea-water and its contents and of methods of estimating the productivity of waters, the construction and standardisation of gear and methods of marine biological work have been undertaken during the last quarter.

The study of the plankton and sea-weeds as food of fish has been regularly pursued. Simultaneously hydrographical investigations have also been conducted to obtain data on pH, sp. gr., salinity, phosphate content, oxygen, and silica content etc. Sea water from the stations at which plankton hauls are made is brought in standard bottles for estimation. An insulated water bottle has been designed in the Laboratory and surface temperatures are regularly recorded. Three hauls of plankton—horizontal and surface—horizontal 15 metre, and vertical are made every alternate day between 5 and 6 a.m. at a station two miles off West Hill, and are examined the same day qualitatively and quantitatively, and the results entered on standardised plankton sheets. The dry volume of each plankton collection estimated by the filtration method is also recorded. Phyto and zoo-plankton abundance seems to alternate in the plankton hauls made during the last quarter. A phyto-plankton peak seems to occur on the Calicut coast corresponding to the S.W. and N.E. monsoons, followed by a zoo-plankton peak. In the Madras coast there is a spring and an autumn peak of phyto-plankton.

A study of the agar-yielding species of Indian *Rhodophyceae* (*Gracilaria* and *Hypnea*) from various localities shows that apart from *G. lichenoides* with an agar-yield of 43% and *G. confervoides* with an agar-yield of 25-30%, there is the third species, *G. corticat* occurring on the W. coast from Karwar to Cape Comorin and thence up to Madras, with an agar-yield of 57%. The estuarine, *Hypnea flagelliformis* which occurs in dense masses in the Adyar estuary appears to be a poor agar-yielding form, but this is believed to be due to the slow dissolution of the agar in the extracting medium.

"Redwater" or "Slimy water" phenomenon on the W. coast: A thick slimy scum was reported from

*Larvae collected on 6th December continue to live and flourish.

surface waters in several fishing centres between Calicut to Gangoli (Coondapur) for a period of about a week which seriously affected fishing operations on this coast. What was at first at the surface spread vertically to a depth of 15 fms. Fishermen found great difficulty in steering their fishing craft and in operating their fishing gear. Some mortality of fish (*Arius* and *Caranx*) was observed, but the insignificance of the mortality considering the widespread nature of the phenomenon presumably indicates that the fish had moved to more off-shore waters. Investigation showed that the slime consisted of nothing but disintegrating *Noctilucae* in enormous quantities. Judging from the quantities of fish landed at the fish-curing yards in Malabar and S. Kanara in the month of October since 1944, the fishery in 1948 seems to have dwindled to 50% of the lowest yield in October 1946 and 25% of the highest yield in October 1945.

PHYSIOLOGY

The adaptive behaviour of *Metapenaeus monoceros* and related prawns and of fishes like *Megalops* and *Chanos* etc. was studied with the help of field data collected at Madras, Cochin and Travancore. The former is the most adaptable from the physiological point of view as its adaption has been found to be brought about by the active regulation of chloride ions by the prawns themselves. The correlation of field data with experimental results in the laboratory is expected to provide a basis for the culture of prawns and other highly adaptable commercial species of fish on a large scale. In this connection refined microtechniques for the estimation of chlorides and urea have been perfected. The relationship of kidney structure to efficiency of function in Teleostean fishes is also being determined with a view to correlate these data with their behaviour under changed environments.

BIOCHEMISTRY

The study of the distribution and seasonal variation of nutrients (compounds of nitrogen, phosphorus, silicon and iron) in the surface in shore waters near Madras has been taken up as a preliminary to a more detailed study involving the collection and analysis of samples of water from various depths when the requisite facilities would be available.

Simultaneous determination of salinity and dissolved oxygen content were carried out as a guide to the analysis and to indicate the nature of the samples. These determinations when carried out over a long period will help in understanding the factors concerned in the changes in the concentration of nutrients. The methods of analysis closely follow those adopted in corresponding laboratories in Europe and U.S.A. and the values expressed are according to the recommendations of the Int. Assn. of Physical Oceanography (1939) and are therefore readily comparable with similar values for other seas. The concentration of nutrients in the surface waters are high when compared to the values reported for tropical waters under oceanic conditions. With the exception of a few marked deviations due mainly to the effect of local conditions there is a direct correlation among the values for nutrients. Nitrates seem to show much wider variations than the phosphates as indicated by the extremely wide divergency in the N/P ratios which are expected to be constant, but are actually not so owing to the instability of the water system, which are affected greatly by currents, land drainage effects, biological activity, etc. As the water samples are made during the early part of the day the phytoplankton activity is indicated fairly well by the content of dissolved oxygen, and under stable conditions, as in the month of August, there exists an inverse relationship between nutrients and the dissolved oxygen and therefore the phytoplankton population. There is thus a remarkable constancy of salinity. The sudden downward trend in salinity from mid-October is correlated with the influx of flood waters into the sea as a result of the monsoons, but there may also be currents of low salinity along the Madras coast during the rainy seasons.

BACTERIOLOGY

It is well known that Bacteria play an indispensable role as producers of plant nutrients in the sea and as mineralisers of organic matter, and also as agents of spoilage of fresh and processed fish. The bacterial flora of inshore open waters and lagoons is at present being investigated with reference to their seasonal variation, relation to phytoplankton and to fish. The bacterial population rises sharply in August-September and falls in October-November to the summer level in April-June and a fairly close relation between the numerical strength of the bacteria and of the phytoplankton during April-December has been established. There seems to be a difference in the samples of bacterial population sticking to plankton-nets and those found free in sea water, and some evidence that this population is affected by the abundance of zooplankton which graze on the bacteria has been obtained. Several physiological groups of bacteria such as (1) nitrate reducing bacteria; (2) urea splitting bacteria; (3) cellulose fermenters; (4) nitrifying bacteria, have been detected. Of these the first is the most numerous,

Three distinct strains of marine chromogenic bacteria have been isolated. Some evidence has been gathered that the phosphorus of decaying phytoplankton is converted to inorganic phosphate only by microbial activity. Investigations on the liberation of phosphate by bacterial action are being taken up in view of the importance of phosphate as plant nutrient in the sea.

Bacteriological analysis of the Adyar river water in Madras was undertaken to determine how far the shell-fish grown in this area are fit for human consumption. Considerable numbers of coliform organisms (*Escherichia coli*) in the shell-fish growing areas have been detected at all times. No relationship between chlorinity and density of coliform organism has been established, but in pH ranges between 7.8 and 8.8 coliform organisms are able to survive and multiply rapidly.

FISHERY SURVEY SECTION

After a rapid preliminary survey of the fishing industry in individual zones, for a period of about six months, covering all general information about the fishing populations, craft and gear, fishlandings and other conditions, the Survey staff is now in a position to conduct more detailed surveys in the more important fishing centres. Standard forms for collection of information have been prepared and given to the survey assistants who will now record definite data on unit fishing effort in relation to the types of craft and gear, number of men employed, size of gear, distance from shore, time spent in effort, qualitative and quantitative estimates of catch and sizes and sexual maturity of fish. It is expected that one complete year's data will provide sufficient material for statistical analysis and scientific interpretation.

CENTRAL INLAND FISHERIES RESEARCH STATION, CALCUTTA

Some of the Universities in India as also the fishery departments in the Provinces and States have in the past made a few attempts at solving certain problems of inland fisheries; but the limitations of staff, finance and facilities have been in the way of methodical research on inland fisheries on any comprehensive basis. With the growing importance of fish farming and the desirability of utilising all culturable waters in the country for food production the need for planned and co-ordinated fishery research on an all-India basis has been recognised. Under existing conditions the Government of India had to undertake research work in Inland Fisheries for a period of 5 years at the first instance in connection with the interim fisheries scheme.

The Central Inland Fisheries Research Station, came into formal existence with the appointment of an Assistant Research Officer in March, 1947, while the Chief Research Officer took charge in June 1947, and the majority of the technical staff were recruited towards the end of 1948. With the return of all the trainees from abroad, the sanctioned staff is expected to be working full strength from 1949 onwards.

The present organisation of the main section of the Station is shown in Statement No. 1.

The objective of the station is to increase the production of fish in inland waters by investigating the nature of their fishery resources, the hydrobiological and other environmental factors influencing them, the optimum conditions for the maximum output and the means of exploiting the different types of fish crop with adequate conservation. While the varied and complex problems relating to the above mentioned aspects of Inland Fisheries would require prolonged research by a large band of workers specialized in different lines, what is aimed at during the five years of work by the limited staff of this Station is only an elucidation of the most urgent problems with an immediate bearing on Aquiculture. Training of suitable personnel for fishery development is also being attended to. Starting with Calcutta/Pulta as the centre of the Research Station, the work will in due course extend to suitable substations in areas which are fairly representative of the different types of water and ecology concerned so that the results obtained could be applied with advantage in similar waters in other parts of the country. Necessary co-ordination with existing research activities of universities and other scientific institutions will also be effected.

The programme of research work is outlined below:—

POND CULTURE

(i) Ascertain and promote the optimum condition of water contents, pond bottom, manuring etc., for maximum production.

(ii) Study the food, feeding and breeding habits, rates of growth, parasites, other enemies and diseases of important freshwater food fishes such as *Labeo rohita, Labeo calbasu, Catla catla, Cirrhina mrigala, Osphronemus gourami, Mugil corsula,* murrels etc.

(iii) Raise fish seed for culture by elucidating the requirements of "bundhs" and other types of breeding tanks.

(iv) Find out cheap and effective methods of weed control,

(v) Systematise the technique of fish culture and

(vi) Establish judicious fishing methods.

ESTUARINE RESEARCH

(i) Conservancy and development measures, by studying the breeding habits and life histories and bionomics of food fishes such as *Hilsa ilisha*, Mullets, *Lates calcarifer*, Prawns etc.

(ii) Prediction and regulation of the yields from the fisheries by ascertaining causes of annual fluctuations.

(iii) Exploiting underfished areas and

(iv) Improving fishing methods

(a) Increase the natural harvest from estuaries and backwaters

(b) Develop brackishwater fish farming by ascertaining and developing to the optimum hydrobiological factors for brackishwater farming and

(c) In view of the increasing demand for fish seed in Provinces and States, exploit salt-water fish seed resources for inland pisciculture by developing seed collection grounds and improving the technique of collection, acclimatisation and transport of saltwater fish seed.

RIVERINE & LACUSTRINE WORK

(a) Improve the direct catch from rivers and lakes by

(i) Locating undertapped fishing grounds through systematic river surveys

(ii) Devising suitable methods of fishing to tackle such grounds.

(b) Conserve the fluviatile fisheries of the river systems as a whole by determining the requirements of migratory fishes in connection with dams and anicuts.

(c) Find out ways and means of enriching the river crop by regional stocking and stream manuring and

(d) Locate breeding grounds and natural nurseries of riverine and lacustrine fishes for increasing the supply of fish seed for cultural purposes,

UNITS OF WORK

Apart from the Divisions of i) Pond Culture, ii) Estuarine Research and iii) Riverine and Lacustrine work, by the nature of allocation of problems, the following special units would be functioning at the Station:

(i) *BIOMETRIC UNIT*: Under an Assistant Research Officer (Inland Biology—Biometrics), who with the help of other officers working on hydrobiology, will try to elucidate the composition and densities of populations of fish and other biota and the fluctuation thereof on a statistical basis under varying conditions in the waters under investigation, the objective being to promote the optimum population conditions for fish productivity.

(ii) *FISH PATHOLOGY UNIT*: Under an Assistant Research Officer (Pathology), to study and control parasites, diseases and mortality of fishes in various stages.

(iii) *FISHERY ENGINEERING UNIT*: Under an Assistant Research Officer (Fishery Engineer) to study the hydrographical conditions of dams and anicuts with reference to fish migration and to devise the best type of fish passes to suit Indian conditions, to standardise the construction and maintenance of fish farms, etc.

(iv) *FISHERY BOTANY UNIT*: Under an Assistant Research Officer (Botany) to study the various aquatic flora harmful as well as beneficial to fisheries, the optimum conditions for the economic regulation of aquatic vegetation, etc.

(v) *FISHERY CHEMISTRY UNIT*: Under an Assistant Research Officer (Chemistry) to elucidate the physico-chemical factors influencing fish productivity, investigate the possibilities of aquatic manuring the effects of algacides and insecticides on hydrobiota, the problem of water pollution, etc.

Further there are the Carcinology Unit, the Hilsa Unit, the Mullet Unit, the Carp Unit, the Fisheries Training Unit etc., also at the Station.

EQUIPMENT

The Station is equipped with essential apparatus and equipment required immediately for commencing laboratory and field investigations, such as microscopes, lenses, microtome, bath, balance, glassware, chemicals, plankton and fishing nets, a small boat, field tents etc. Additional items including power boats, gear, transport truck etc., have been indented for and other necessary equipment would be arranged to be obtained in due course.

4

THE ORGANISATION AND UTILISATION OF PLANKTON INVESTIGATIONS

by H. Thompson

Plankton investigations are an indispensable concomitant of exploratory work and of hydrological and fishery biological studies. However, they require careful planning in order to avoid being unproductive and to ensure prompt working up, interpretation and utilisation. The accumulation of unexamined collections is to be avoided.

UTILISATION

The following are some of the results to be looked for from plankton investigations:—

1. On the *qualitative* side: (a) a knowledge is secured of the types of organisms occurring during exploratory work in little known waters, which can then be classified as to type—e.g. antarctic, subantartic, cold temperate, warm temperate, subtropical, tropical; or Pacific (east, oceanic or west), Indo-Pacific, Australasian etc. Such a knowledge aids the hydrologist and affords a rough idea of the class of fishery to be anticipated;

(b) aids are provided for the detection (at a sufficiently early stage to allow of prediction in the fisheries) of significant annual and seasonal fluctuations in oceanographic conditions. Thus unusual incursions of salps to the North Sea have been correlated with relative absence of herring, and, in Newfoundland waters, the easily observed variation in the degree of the springtime incursion of a large Arctic species, *Oikopleura vanhoffeni,* indicates variations in the fishery for codfish, which in that region are most plentiful in cold water;

(c) in the case of a prolific fishery—e.g. that for herring in the North Sea—plankton indicating apparatus may be devised as a practical guide to fishermen;

(d) material (eggs, larvae and food organisms) are obtained and afford information on spawning grounds, distribution and life-histories.

2. On the *quantitative* side, hydrological studies of water-productivity can be assisted. Volumes or serial and sufficiently numerous hauls of plankton taken by standard nets (especially vertical hauls with closing nets) yield results which have a certain quantitative value—a value which will be enhanced where chemical analyses, or their equivalent, follow. Counting of predominant organisms also has some limited value.

COLLECTION

As the plankton is not uniformly distributed most reliable results will be forthcoming if multiple collections are made.

(a) **Use of Net:**—In order that results in different regions should be comparable it is desirable to use standard nets, such as those operated in the "Discovery" expeditions. For more strictly qualitative purposes there is a tendency to advocate the use of the Hensen net with flowmeter (vertical hauls). There is said to be a minimum of turbulence in the case of the Hensen net, whose filtration coefficient is said to be = 1. For horizontal hauls the Clarke-Bumpus net, with flowmeter, is favoured.

(b) **Use of Pumps:**—For micro-plankton collection the pumping and filtering of a given volume of water is usually preferred. As catch varies with rate of pumping and diameter of inlet, a flowmeter should be used. It has been found that the pressure gradient at the pipe entrance can allow certain larger organisms—e.g. Euphausids—to escape in significant quantities.

TREATMENT OF MATERIAL

For reference purposes it is of value to record total volume of the collections and to make counts of the more important organisms, the accurate identification of which is of the utmost importance. Aliquot samples should therefore be examined by experts in various groups.

Increased attention is being given to function, especially in the case of phytoplankton and microflagellates, which are important as food of fish larvae. Catches can be evaluated as dry weight or for inorganic content as ashed weight; or they may be sorted, each component (e.g. salps, crustacea, medusae etc.) being expressed as phosphate per square metre of ocean surface (from the ashed weight X required factor for each organism). Diatoms may be estimated colorimetrically after chlorophyll extraction by acetone. Flagellates may be counted with a haemacytometer.

5

KOREAN FISHERIES

Their present and future

by Chyung Moon Ki, Planning Board, Republic of Korea

I. OUTLINE

Korea is a peninsula. It faces, in the east, a deep sea whose greatest depth is 3,712 metres and whose tidal range is only about one metre; in most of the eastern sea there flows a cold current. In the western sea, the difference between ebb and flow is about ten metres and the greatest depth is only 84 metres. Throughout the coast line, long sand beaches and deltas face the famous shallow sea of Whang Hai. In the southern coast, many islands form an archipelago which is most suitable for the growth of marine organisms. Inland, there are many rivers and streams such as Tuman River and Yalu River which start from the Chunji Lake on top of Mt. Paiktoo. There are many dams for electric power and irrigation purposes. All the inland waters provide fresh water for the multiplication of fresh-water fish. In the eastern sea, where the cold and warm currents meet, a single kind of plankton, which is the food for fish, grows richly, and such cold current fish as alaska pollock and such warm current fish as pilchard are so richly produced as to permit one of the highest peaks of production in the world. In the coastal sea of Whang Hai where salt and fresh water mix, the extensive tidal sand beach is wide open and the organic fertiliser is abundantly produced. Such warm current fish as corvenia, lobster and *Ilisha elongata* (a species of herring), and such molluscs as clam (*Cytherea meretrix*), *Tapes philippinarum*, and octopus (*Octopus octopodia* or *poulpe*) find their breeding ground everywhere. In the archipelago where the proper current receives the organic fertilizer poured in from the islands and inland, a cradle region of propagation of various marine creatures is formed and such marine plants as dulse, Japanese jelly plant (*Gellidium unamino*) and *Gloiopeltis furcata* (or *Gloiopeltis tenax*) find one of their richest grounds in the world. As to the inland waters, the Yalu River includes both cold and warm regions and produces richly such delicious fish as Yulmagi (*Brachymystax lenok*) and Sarugi (*Thymallus jaluensis*). The Chungchun and Naktong Rivers produce *Plecoglossus altivelis* (a kind of trout). The Keumkang and Yungsan Rivers produce their own particular kinds of Chong U (*Leiocassis dumerili*). About 700 kinds of fish are found in Korean coastal seas and inland waters; of them over 150 are fresh water fish.

In the north, the coastal sea, where flatfish and sole have their gathering grounds, leads to the Ochkotsk Sea, which is one of the three greatest fishing grounds in the world. In the south, the eastern China Sea, which is west of Cheju Island and into which the Yangtze River drains, contains precious trawl fishing grounds. It leads to Borneo and the Sunda Straits, which are the cradle regions for tropical fish and reaches the Antarctic Ocean, which is the home of whaling.

The coast line is unusually developed. On the main land alone it is 8,693 km. long. When the 3,305 coastal islands are added, the coast line has a length of 17,269 km. Fishing grounds can be found almost everywhere in the coastal sea of Korea and, except for those of the coast of Wungi, none of the ports is frozen in winter, and practically all of the ports are open for fishing vessels throughout the year. If proper measures are taken and processing facilities are provided, the fishery can be naturally developed in this region so lavishly provided for fishing.

Though there were such rich grounds for fishing, the industry could not be developed in the feudalistic period when the people, from their ignorance and prejudice, ignored the good grounds and fishermen clung to the in-shore grounds without even thinking of the oceans. However, from the beginning of the 20th Century, modern scientific technique and capital were imported, and the Korean fishery began to see rapid development. Especially in 1922 when the fishing ground for pilchard in the eastern sea was found, and during the ensuing 20 years, that single kind of fish made new record, both in its production and processing, unparalleled in the history of the world. Truly in the 1930's, the Korean fishery met its golden age. In 1939, total production reached 2,625,199 tons, with a value of 327,322,568 Won (about U.S. $80 million): fishing 151,098,000 Won; cultured 8,307,876 Won; processed 167,916 Won. In that year, the fishery represented 18% of the whole Korean industry, and thus it was next only to agriculture, and Korea became the second fishing nation in the world.

The main marine organisms of Korea include about 120 kinds (fish 75 kinds, shell fish 20 kinds, marine plants 15 kinds, and other 10 kinds). In

1937, the marine products whose value exceeded one million Won each (about 250 thousand dollars) were about 21 in number, as the following:

1.	Pilchard	1,206,700 tons	54,780,000	Won
2.	Alaska Pollack	269,510 „	21,020,000	„
3.	Corvenia	78,800 „	8,190,000	„
4.	Mackerel	62,260 „	8,160,000	„
5.	Laver	2,610 „	7,624,000	„
6.	Anchovy	30,040 „	5,080,000	„
7.	Hair Tail	44,640 „	4,720,000	„
8.	Herring	36,670 „	4,580,000	„
9.	Lobster Shrimp	43,120 „	3,750,000	„
10.	Cod	17,690 „	2,450,000	„
11.	Sole	11,190 „	1,930,000	„
12.	Horse Mackerel	7,800 „	1,740,000	„
13.	Korean Dulse	5,150 „	1,760,000	„
14.	Croaker	5,470 „	1,630,000	„
15.	Umu Kasari (for Agar Agar)	1,050 „	1,593,000	„
16.	Porgy	1,930 „	1,460,000	„
17.	Chup Mackerel	2,870 „	2,870,000	„
18.	Glue Seaweeds	980 „	1,200,000	„
19.	Conger eel	4,910 „	1,120,000	„
20.	Flatfish (tongue fish, halibut)	3,340 „	1,080,000	„
21.	Octopus	4,950 „	1,060,000	„

The main processed commodities produced were as follows:—

FOR FOOD:

1.	Dried Fish	57,040 tons	26,000,000	Won
2.	Salted Fish	61,250 „	11,000,000	„
3.	Dried Boiled Fish	16,560 „	10,000,000	„
4.	Fish saltenzimmed	16,030 „	5,300,000	„
5.	Canned Fish	13,030 „	4,600,000	„

FOR OTHER PURPOSES:

1.	Fish Fertilizer	262,860 ton	53,830,000	Won
2.	Fish Oil, Fish Bowel	112,530 „	35,000,000	„
3.	Sea-Weeds	3,690 „	36,500,000	„

In 1939, the amount of exports reached 117 million Won (about U.S.$28 million at that time); 28% of the products were exported to Japan.

After the fishery reached its golden age, strangely enough, from 1941 when the Pacific War broke out, the migration of pilchard, which occupied more than half of Korean fishery products was suddenly interrupted. Moreover, Japan, with the motto "Why shall we not use the treasures which have been developed for 36 years?" abolished the laws for the protection of fish reproduction and exhausted the marine resources for her war purposes. Thus the products gradually decreased, and from 2,046,243 tons in 1939 they fell to 1,318,041 tons in 1941, 845,782 tons in 1942 and finally in 1944, fishing of pilchard was eliminated. As the war went on, materials were in short supply, the sea was dangerous and the marine resources were decreased because of the unrestricted catching. The total products were only 690,000 tons in 1944.

II. PRESENT CONDITION

1. Amount of products:

Since the liberation, Korea has been divided into two parts. The actual condition in North Korea is not known, and no account of the fishery of the whole of Korea can be given. If we estimate from the evidence in hand, judging from the 268,146 tons of fishery products in South Korea in 1948, the fishery products throughout Korea may be estimated at about 450,000 tons. Thus, it has not reached the previous average record (600,000 tons for the whole of Korea, 300,000 tons for South Korea) of the products. The main cause is the unrestrained fishing, that is no estimate was made each year, after careful investigation and estimation of whole marine resources and the amount of reproduction of the amount of fishing which would not hinder reproduction. If this situation is left as it is, the amount of coastal fishing will gradually decrease. Among others, the resources of cod fish are being dried up. The products of cod in South Korea were 13,046 tons in 1947, but they were decreased suddenly to 5,124 tons in 1948.

CATCH FOR ALL OF KOREA
(1938 — 1943)

Year	*Tons*
1938	1,596,033
1939	1,905,033
1940	1,609,494
1941	1,189,909
1942	704,662
1943	633,107

SOUTH KOREA: A. CATCH, B. PROCESSED COMMODITIES

A.

Year	General Fishes		Shell Fish		Sea Grasses		Other Sea Animal and Plants		TOTAL	
	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price	Quantity	Price
1937	537,834	34,844,918	15,898	1,342,093	28,877	2,221,317	54,622	3,946,506	637,231	42,354,634
1938	525,358	38,562,717	17,232	1,456,704	40,460	2,131,507	45,713	4,054,390	628,763	46,203,318
1939	499,059	50,999,149	10,307	1,568,163	41,003	4,852,556	49,183	6,540,783	599,552	63,960,652
1940	454,506	63,326,049	10,958	1,826,753	34,574	5,245,829	45,172	8,139,948	545,210	78,538,579
1941	363,674	63,045,483	14,606	2,476,846	33,131	5,090,533	51,502	10,797,533	462,913	81,413,395
1942	288,453	70,098,623	28,054	3,072,382	28,313	5,979,429	32,528	12,374,151	377,348	91,524,585
1943	281,597	76,820,287	13,411	3,220,676	48,185	8,033,165	44,948	15,624,329	388,141	103,698,457
1944	194,022	85,235,100	6,376	2,120,234	15,360	3,575,000	18,755	7,491,523	234,513	98,421,857
1945	205,236	398,885,391	10,496	11,317,885	23,037	26,379,225	19,018	27,086,629	257,797	545,669,130
1946	245,902	2,323,345,703	20,640	144,674,632	19,144	162,672,289	23,567	221,627,373	309,253	2,852,319,997
1947	302,231	6,518,306,000	5,049	136,018,000	7,683	440,558,000	27,594	655,030,000	301,952	7,749,912,000
1948	206,263	12,481,039,000	6,940	363,323,000	7,821	553,792,000	47,050	1,309,390,000	268,146	14,707,544,000

Quantities are given in tons

B.

Year	Dried		Salted		Canned		Others		TOTAL	
	m/t	Value	m/t	Value	m/t	Value	m/t	Value	Tons	Value
1937	22,768	7,193,903	29,265	4,202,983	2,026	1,554,646	90,755	16,617,104	144,814	29,568,636
1938	22,341	8,774,992	27,056	3,720,059	3,161	2,308,217	80,937	17,531,483	133,495	32,334,751
1939	27,585	14,007,362	37,929	6,778,510	9,355	2,602,815	73,414	28,668,578	148,283	52,057,265
1940	25,963	19,062,892	33,304	8,412,663	3,212	2,858,861			135,670	70,220,546
1941	25,427	21,142,671	40,616	12,033,140	2,950	3,901,246	62,985	42,160,543	131,978	79,237,600
1942	24,111	21,196,364	47,950	13,508,651	2,650	3,098,041	28,014	39,775,285	102,725	77,578,341
1943	22,411	31,794,548	33,815	13,223,615	1,098	2,712,687	13,737	41,084,292	71,061	88,815,142
1944	12,961	29,527,387	25,300	26,555,494	2,151	3,415,520	7,445	23,386,800	47,857	82,885,201
1945	15,290	29,527,387	26,770	46,402,103	362	2,062,540	8,392	29,741,168	50,814	212,018,053
1946	13,576	445,547,658	54,860	434,385,321	465	8,340,540	5,352	183,079,682	73,253	1,071,353,201
1947	22,856	1,113,869,145	25,418	304,069,724	108	2,502,162	5,319	274,619,523	53,701	1,695,060,554
1948	20,966	2,805,773,413	18,326	658,776,320	305	10,215,321	4,716	482,221,753	44,313	3,956,986,807

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Shell Fish The principal species in the above catch are cockle shell, abalone, sea mussel, oyster, topshell, clams and scallops.

Fertilizer, Fats and Oils

By products output for 1945:

Fresh Fertilizer, 69 m/t
Dried Fertilizer, 83 m/t

By-products output for 1946:

Fresh Fertilizer, 112 m/t
Fats and Oils 21 m/t

The estimated potential production of shellfish is 55,000 metric tons. Fertilizer, 200 m/t; fats and oils 50 m/t. Since the production of most of these by-products is confined to coastal areas, there would be little international competition.

CLASSIFIED CATCH FOR SOUTH KOREA

(1948)

Kind	*Produce*
1. GENERAL FISHES	
Total	206,263
Ray	7,245
Flounder	6,003
Kand-da-ri	435
Black Porgy	342
Mackerel	10,151
Saury-pike	436
Halibut	1,352
No-re-me	588
Perch	1.013
Cod	5,124
Porgy	1,346
Alaska Pollack	11,868
Anchovy	13,151
Croaker	1,250
Yellow Tail	4,123
Eel	836
Pomfret	301
Gray-rock-cod	1,005
Conger eel	1,231
Chub-Mackerel	2,935
Shark	13,053
Tongue fish	1,411
Mullet	2,301
Sandlance	924
Horse Mackerel	12,123
Corvenia (Cho-gi)	35,285
Flat Fish	613
Pilchard (sardine)	11
Herring	416
Hair-tail	8,210
Shad	932
Other fishes	70,250
2. *SHELL FISHES*	
Total	6,940
Worm-shell	128
Oyster	1,810
Clam	598
Cockle	95
Abalone	730
Scallop	520
Other-shells	2,859
3. SEAWEEDS	
Total	7,891
Dulse	4,210
Jelly-weed	1,103
Laver	1,492
Glue-weed	180
Other weeds	906
4. *OTHER SEA-ANIMAL*	
Total	47,050
Crab	623
Whale	3,050
Octopus	1,519
Shrimp	14,146
Cuttle-fishes	19,230
Sea-slug	1,389
Others	7,097

GRAND TOTAL 268,146

CLASSIFIED PROCESSED COMMODITIES IN SOUTH KOREA

1946

	Quantity	*Value*
GRAND TOTAL	74,253	1,040,342
Total, Foods	72,960	1,030,617
Dried Food	5,407	152,411
Salted & dried	1,210	42,633
Boiled and dried	6,679	240,284
Salted	43,492	359,183
Salted & acid	10,799	75,201
Canned	460	8,013
Eatable sea-weed	3,308	103,279
Other foods	1,605	49,609
Total, Uneatable	1,293	10,725
Dried fertilizer	289	1,734
Oils	165	5,206
Medicinal	3	10
Seaweed	836	3,713
Other uneatable	—	—

Note: Unit, Quantity—Metric Ton
Value —W. 1,000

2. Fishermen

In 1947, the fishermen in South Korea numbered 504,626. Among them 336,973 were actual fishermen. 136,337 were engaged in culturing, and 1,511 were engaged in processing.

3. Fishing Boats

(1937 — 1942. All Korea)
(1945 — 1948. South Korea)

	1937		1942		1945	
Type	*Number*	*Tonnage*	*Number*	*Tonnage*	*Number*	*Tonnage*
Fishing Powered	2,543	35,602	3,277	45,878	2,311	32,354
Fishing Sail	48,981	146,943	61,879	185,637	40,015	120,045
Powered Carrier Vessels	4,370	61,180	4,132	57,848	1,066	14,924
Totals	55,894	243,725	69,288	289,363	43,392	167,323

	1946		1947		1948	
Type ..	*Number*	*Tonnage*	*Number*	*Tonnage*	*Number*	*Tonnage*
Fishing Powered	1,953	27,343	1,910	26,740	2,792	33,703
Fishing Sail	35,707	107,121	35,840	107,520	44,138	173,200
Powered Carrier Vessels	392	5,488	371	5,194	818	8,993
Totals	38,052	139,951	38,121	139,454	47,748	215,896

Type and Tonnage of Power-Driven Boats in South Korea, 1948

Ton

Type	1—10	10—20	20—50	50—60	60—75	70—80	100
Whaler	33	10	5	—	1	—	—
Semi-trawler	3	166	45	34	4	1	1
Purse Seine	1	35	5	—	—	—	—
Diving	250	—	—	—	—	—	—
Gill Net	650	138	—	—	—	—	—
Fish carrier	601	183	34	3	—	—	—
Others	1,145	390	21	4	1	—	—
Totals	2,653	902	110	41	6	1	1

Note: All boats are of wood. Source: Bureau of Fisheries, Dept. Agriculture, USAMGIK

a. *Powered Vessels*

(1) (Information is based on 1937 statistics). All vessels were of wooden construction. 1,635 vessels were less than 45′ in length. Of these, 125 were diving vessels; 340 gillnet vessels; 1,000 long-line vessels and 170 other types. There were 5,278 vessels 45—59 feet long. Of these 11 were whalers, 220 seine-trawlers, 440 purse seiners, 110 gillnet vessels, 4,370 fish-carrying vessels and 107 other types. The figures given are for all of Korea.

(2) Current figures based on South Korea statistics are:

	1937	*Current*
Diving Vessels	125	114
Gill Net	340	127
Long line fishing	1000	845
Other	170	302
Total vessels less than 45 ft.	1635	1388
Whalers	11	17
Seine trawlers	220	219
Purse Seiners	440	32
Gill netters	110	30
Carriers	4370	371
Other types	107	224
Total vessels 45 — 59 ft.	5258	893

Purse seine, bottom drag net, whaling ship, and timbers for shipbuilding are wanting.

b. *Nonpowered vessels*

(1) Statistics based on 1937 figures for all Korea.

Sampans, less than 15′ long for trapnetting and miscellaneous fishing .. 2,136

Boats 15—30′ long:

Trapnetting ..	1,600	
Long line fishing ..	8,270	
Miscellaneous ..	1,282	.. 11,152

Boats 30—40′ long:

Trapnetting ..	1,370	
Dragnetting ..	2,550	
Swingnetting ..	1,820	
Gillnetting ..	3,839	
Long line fishing ..	9,587	
Spreadnet fishing ..	3,112	
Fishcarriers ..	1,879	.. 24,157

Boats over 45′ long:

Dragnetting ..	1,420	
Swingnetting ..	3,940	
Gillnetting ..	280	
Spreadnetting ..	1,220	
Fishcarriers ..	1,446	.. 11,536
Grand total		48,981

(2) The current fleet consists of:

Boats 15′ — 30′ long:

Trapnetting ..	1,246	
Miscellaneous ..	1,421	.. 2,667

Boats 30′ — 45′ long:

Trapnetting ..	972	
Dragnetting ..	1,321	
Swingnetting ..	952	
Fishcarriers ..	256	
Gillnetting ..	2,298	
Long line fishing ..	7,640	
Spreading netting	2,673	.. 16,112

Boats over 45′ long: 6,926

Grand total 25,705

(3) Requirements for future development include no increase in the smaller type vessels but do call for an increase in those forty-five feet or longer, for dragnetting, long line fishing and fish carrying.

4. Fishing Equipment

Over 80 different kinds of fishing methods are used in South Korea at present. They include such modern fishing techniques as drag net fishing and purse seine fishing but also such primitive fishing as diving and single line fishing. The licences issued number 124,000. The fishing can be divided into that on fixed ground and removing fishing. A list of types of fishing employed in Korea is given as appendix 1.

Types of Gear, Weirs and Other Fishing Equipment

	1946	*Requirements*
Stow' nets	120	153
Square nets	159	200
Raising nets	48	610
Small head pole nets	418	151
Fall nets	44	459

	1946	*Requirements*
Swing nets	245	268
Bauck nets	1,492	909
Roe nets	409	619
Weirs	379	439
Shore seines	2,271	1,698
Open tucks	513	814
Spread nets	105	146
Bowed nets	3,507	126
Raising ring nets	45	81
Purse seines	75	432
Tuck stone nets	606	423
Ring gill nets	77	146
Scoop nets	781	2,147
Drift nets	112,762	113,360
Gill nets	4,914	—
Trawl line	22,996	41,421
Single line	5,000	20,737
Cormorant fishing	208	500
Pot nets	4,274	944
Defensive sq. nets	8	366
Double nets	298	612
Dredging nets	551	937
Set	—	19
Haul nets	—	4,293

5. Ice Making Freezing & Cold Storage

Thirty-one ice plants were located in South Korea prior to 1945. Many of them were dismantled by the Japanese during and immediately after surrender. However, as machinery, equipment and supplies become available each plant is being placed in operation. Total capacity of the thirty-one plants is 824.5 tons. About fiffy per cent of these are now in operation and approximately two-thirds the output is used for icing fish vessels. The ice in most loadings is sheared into "snow ice" thus enabling better icing of the fish and also longer freezing of the product.

Iced fresh fish is transported to every section of South Korea in a well preserved state.

Freezing and cold storage total capacity is 300,000 metric tons.

6. Processing

(a) *Salting* (See Table, Page 85)

Future production of dried fish is estimated at over 100,000 metric tons annually. Annual salt requirement is 100,000 tons.

Operations are carried on with crude materials. Both dry salting and boiling are employed. The bulk of the products is made in the localities in which the fish are landed.

Salt is obtained from salterns and is imported from China and the United States.

(b) *Drying* (See Table, Page 85)

In 1948 the total amount of dried fish was 20,966 metric tons. The future program calls for greatly increased production of dried fish, especially for export. Extensive installations for drying fish are not at present available. The two methods used are boiling and drying and sundrying after evisceration. More sanitary methods are now being introduced.

(c) *Canning* (See Table, Page 85)

There were thirty one canneries in South Korea prior to the war. The Japanese destroyed or removed much of the machinery and equipment, leaving the plants in an inoperable condition. Thirteen have now been rehabilitated to a certain degree by cannibalization of machinery, equipment and supplies. A total of 200 metric tons of canned goods was produced in 1948.

Since nearly all of the fish catch is now consumed by the population in the form of fresh, salted or dried fish, and because of the acute shortage of tinplate, the plants are now being kept in operating order for future export of canned products. However, the production of crab is very rich and in 1949, a great number of empty tin cans has been imported through ECA from U.S.A. Thus, about 80 tons of canned crab can be exported.

(d) *Fishmeal and byproduct oil*

Prewar — All Korea

1935	..	74,032 m/t
1936	..	88,890 „
1937	..	126,114 „
1938	..	95,218 „
1939	..	113,866 „

The end-products were fertilizers, soap and textile preservatives. Potential production is estimated at 20,000 m/t. The principal sources of fish oil was the sardine (Sardinops). Fish meal was a byproduct. The entire product was handled as nonedible, and was not connected with canneries. Sardines have since disappeared; but they may return.

Whaling constitutes a source of fish meal and oil. Whale oil output was 152 m/t in 1948.

The future production of meal, fertilizer, oils etc. is being given serious thought, and research is now being conducted with non-edible fish and

marine life to replace the sardine. Halibut and cod livers are preserved for vitamin oil of which a large output is expected in the next few years. This is an industry new to Korea.

7. System of marketing

Fishermen deliver catch to the Guilds and Unions which act as co-operative agencies in selling the produce to the retailers. Many of the middlemen have been eliminated thus assuring fair prices to the fishermen for their products, as well as reasonable prices per fish to the consumer. No retailer is allowed to control the market or price of any particular species, as was formerly possible. Only a certain number is placed in each box for sale and each retailer is limited in the number of boxes he may purchase daily. Prior to surrender each species was placed in one large pile and sold to a single individual, who, by purchase of all of the one species available, could control the retail sales price.

8. Fish and Shell fish Culture

There were two provinces in South Korea which, prewar, had fish hatcheries: Kyansang Namdo and Kyongsang Pukto. Carp were produced in the former province. During the war production was reduced to a minimum.

Year	*Youg Fry*	*Eggs*
1939	1,315,000	1,570,000
1940	961,800	1,845,000
1941	1,120,400	930,000

Kyongsang Pukto hatchery produces cod and herring; in 1939, 19,668,000,000 in 1940, 12,240,000,000. Eggs were hatched and released shortly after hatching. It did not operate during 1943-45.

An extensive artificial eggtaking program is carried on during the cod season. Numerous vessels are employed. The adult cod are taken from the sea, the eggs stripped, fertilization is effected and the fertilized eggs released into the sea. 20,000,000,000 eggs were fertilized and released into the sea during the 1945/46 season; 25,000,000,000 during 1946/47; 30,000,000,000 during 1947/48.

Kyongsang Namdo hatchery was partially reopened in 1946 and 165,00 young fry eggs produced. In 1947 300,000 young fry were produced; in 1948; 400,000. Repairs are now being made and the planned program calls for vastly increased production in 1949.

The new hatchery in Kyonggi Do was operated for the first time in 1944. Production was 14,800 young fish and 30,000 eggs. There was no production in 1945-47, but in 1948, 200,000 young fry were produced. Repairs are now being completed to achieve maximum production. Kyongsang Namdo hatchery and rearing grounds cover 42 acres; Kyonggi Do has 20 acres with 23 rearing ponds. The program for the above hatcheries calls for a production of 100,000,000 fry.

Eight other hatcheries and rearing ponds are now contemplated, to be located at strategically central points for local distribution to increase inland-water food production. The fry will cost the farmer five chun each and will be placed in the local streams, pools, ponds and rice paddies.

Future operations calls for greatly increased production in all of the above fields and require the full utilization of all hatching, rearing and collection facilities to make available an effective supply of carp, which is the best kind of fresh water fish for this purpose in Korea. It stands transportation well.

There have been no shellfish culture projects. Shellfish are collected from naturally-occuring beds. A program of oyster culture is under study and research.

9. Per Capita consumption

1940	..	18.78 lbs.
1944	..	22.50 „
1947	..	35.05 „

III. ADMINISTRATION

I. Statistics

Production, marketing and biological information is collected by provincial sections of the Bureau of Fisheries which has a statistical section to facilitate the collection of data. This information is transmitted to the National Office where it is edited and distributed.

Biological and scientific information is collected by the research and experimental stations which are under the National Bureau of Fisheries. Statistics are collected by various agencies—Unions, Guilds, Co-operatives, Associations. Publishing is done by the Department of Commerce from materials supplied by the provinces. The Department of Public Information and Education supplies radio material and newspaper information. Aeroplanes are also used to distribute information.

2. Technological Research and Education

A large volume of these records is available at the main Research and Experiment Station but all are in Japanese and translation is slow due to the lack of personnel to do this work.

3. Conservation Research

The setting up of an effective and efficient conservation program is now in progress. This aims at the regulation of coastal waters, of the size of net mesh, the size of fish, season of take, amount of catch, use of explosives, range of various types and sizes of vessels, inshore fishing limits, protection of spawning beds, and so forth.

4. Regulating Policy

Inshore fishing grounds are leased. The National Bureau regulates the leasing of fishing grounds which are closed to persons not having possession of the rights to any particular grounds. These grounds are in the greater part leased to fishermen residing in villages adjacent to the fishing grounds. At present there is also an international regulation controlled by the Far East Command prohibiting Japanese encroachment of Korean fishing areas. This is enforced by the Coast Guard and Customs Office.

Changes under consideration are programs to eliminate waste by enforcing more sanitary methods of handling and marketing, and a system of patrol conducted by the Bureau of Fisheries.

The fishermen form Fisheries Guilds in each district and the Fisheries Guilds form Fishery Associations in each Province. Large-scale operatives and fishermen engaged in special types of operations, from their own Marine Association according to their own kind. Under the leadership of the Korean Fisheries Corporation, they exchange fishing equipment and capital. In South Korea, there are:

Fisheries Guilds	204
Fisheries Associations	7
Marine Associations	11
Korean Fisheries Co-operative	1

6. Research and Experimental Stations

Korea has the Pusan Fisheries Laboratory and Pusan Fishery College. Professor Chyung Moon Gi is President of the latter.

7. Inspection Stations

There are seventeen Inspection Stations. The main station is located in Seoul and there are two in each province. Eighty persons are required to staff and operate the stations. Their functions are to inspect all marine products, including fish both for home consumption and for export. These stations also inspect fish oils and all seaweeds.

8. Fishing Materials

Of essential fishing materials, Korea needs heavy oil, light oil, manila rope, cotton net, cotton thread, timber, lead, rubber, tinplate, ammonia, bamboo, salt and many other items. Since the liberation, the fishermen have been maintaining their fishing with the materials left over or materials in hand, but there has been very little supply of new materials within the country. They have to be imported from outside. (See Five Year Plan below).

In contrast with the golden ages in the past, the present fisheries are making poor use of their rich possibilities. However, when compared with other industries in Korea, the importance of the fisheries cannot be overestimated. It is a most urgent and important national task to plan for the development of fisheries, for this will contribute to a solution of the problems of health and food and of maintaining the balance of international trade. To establish the counterplan for the future, it is necessary to investigate and understand the present status of technicians, materials and marine resources.

The fishing population of South Korea is 340,000, and forms only 1.7% of the whole population. In contrast to Japan, the fishing population was distinctly small. In view of the importance of fisheries, the population could be increased by 50% of the present population. One thing to be noticed concerning the fishing population is that most of the fishing business men with the education of high school or higher, have entered the industry only since the liberation. Their experience, technique and capital will have to be supplemented in the future.

From this point of view also, the guidance and protection by the Government are greatly needed. Among the fishing materials, more important materials such as timbers for shipbuilding, motor engines, thread for nets, oil for fishing have to be imported from outside to increase the output. While marine resources must be protected by a conservation policy, deep-sea fishing and inland water fishing will, on the other hand, have to be positively promoted.

9. Five year Plan of Development

A five year plan for development of Korean fisheries has been formulated. Its main features are shown in the following:—

FIVE YEAR PLAN FOR SOUTH KOREAN FISHERIES

Production classified by the kinds of water

(1949 — 1960)

	1949	1950	1951	1952	1953
Coast	287,500	283,500	270,000	265,000	260,000
Inland	2,500	2,500	5,000	5,000	10,000
Deep Sea	10,000	15,000	35,000	45,000	50,000
Totals	300,000	300,000	310,000	310,000	320,000

	1956	1958	1960	1965
Coast	230,000	220,000	230,000	300,000
Inland	20,000	20,000	20,000	20,000
Deep Sea	70,000	80,000	80,000	80,000
Totals	320,000	320,000	330,000	400,000

Note: If the number of licenses is properly limited, the breeding grounds are protected, the fishing during the breeding seasons and fishing of immature fish are properly prohibited, and thus reproduction is promoted, then, beginning 1965, the coastal resources will naturally be increased and reach 300,000 tons. Consequently the total marine products can be secured to 400,000 tons.

Production classified as fish, shellfish, sea-weeds and others

(1949 — 1953)

	Fresh Fish	Shell Fish	Seaweed	Others	Total	
1949	262,400	4,900	7,800	24,900	300,000	tons
1950	262,400	4,900	7,800	23,900	300,000	„
1951	269,500	6,040	7,980	26,480	310,000	„
1952	269,500	6,040	7,980	26,480	310,000	„
1953	27,800	7,200	9,600	32,400	320,000	„

Materials to be imported for Five Year Plan

To produce 300,000 tons in the coastal seas, 80,000 tons in the deep seas, and 20,000 tons in the inland waters (the total amounting to 400,000 tons) under the Five Year Plan, the following materials will have to be imported from outside.

1. Fishing boats materials, wooden .. 10,444 tons (per year)
2. Deep sea fishing boats 30 boats („)
3. Cotton yarn for fish-net 2,268 tons („)
4. Manila hemp .. 1,667 tons („)
5. Fishing Oils .. 49,129 tons („)

Other items of considerable variety required in comparable amount.

Appendix 1.

Main Korean Marine Organisms of Commercial Value

English Names	*Korean Names*	*Scientific Names*
Pilchard	Chong-o-ri	Sardinia melanosticta
Alaska pollack	Myong-tao	Thoragra chalcogramma
Corvenia	Chaki	Nibea manchurica
„	Poku-tchi	Nibea schlegeli
Mackerel	Kodeung-o	Scomber japonicus
Anchovy	Myol-tchi	Engraulis japonicus
Hairtail	Kal-tchi	Clupea pallasi
Herring	Tcheng-o	Trichiurus japonicus
Shrimp	Sao-u	Acetes japonicus
„	„	Pasiphaca sivodo
„	„	Sergestes phosphorous
Lobster	Tae-ha	Penaeus japonicus
„	„	Pandalus hypsinetus
Cod	Tae-ku	Gadus macrocephalus
Sole	Kajyami	Limanda angustriestris
„	Bom-kajyami	Verusper variegatus

English Names	*Korean Names*	*Scientific Names*
Sole	Norang kajyami	Verusper moseri
Korean dulse	Myok	Undaria pinnatifida
Croaker	Min-o	Nibea imbricata
Umukasari	Umukasari	Euchouma amalisaousis
Chopmackerel	Sam-tchi	Sawara japonica
Glue seaweed	Semo	Gloiopeltis tenax
»	Pul-tungi	Gloiopeltis furcata
Conger Eel	Bung-chang-o	Conger ruyriaster
Muraenesox eel	Kact-chang-o	Muraenesox cinerous
Flat fish	Nop-tchi	Paralichthys olivaceus
»	Ka-ja	Areliseus holandi
Octopus	Nak-chi	Polypus variabilis
»	Moon-o	Polypus vulgaris

Appendix 2

List of Types of Fishing Gear Used in Korean Waters

FIXED GEAR

Name	*Korean Name*
Stow Net (2 kinds)	Dae Momang
Square Net (3 kinds)	Kack Mang
Raising Net	Dul Mang
Small Head Pole Net	Sodae Mang
Swing Net	Doi Mang
Fall Net (2 kinds)	Nack Mang
Bag Net	Bing Mang
Basik Net	Dadeboshi Mang
Chubock Net	Chubock
Bang yom	Bang yom
Weir	Sal
Bu Net	Bu Mang
Chung son net	Chung son Mang
Gill net (7 kinds)	Tchocko-kumul
Long line (10 kinds)	Chunak
Set net	Kun Mang

MOVABLE GEAR

Name	*Korean Name*
Beach seine	Furi kumul
Kwon hyon Mang	Kwon hyon Mang
Sail drag net	Bae furi kumul
Ang Kan net (3 kinds)	Ang Kang Mang
Sailing bottom draft net	Bae choyo Mang
Shell Net	Chokae kulki Mang
Cast Net	Too Mang (che aengi kumul)
Purse seine (4 kinds)	Kison Konchaek Mang
Drift Net (5 kinds)	Fullim Kumul
Draft and gill net (2 kinds)	Fullim Tchocko
Danish seine	Kison joyo Mang
Single line (6 kinds)	Nacsi
Nude diving	Najam
Whaling	Phokyong
Whaling Scoop net (tuck stone net)	Cho Mang
Double net	Chung son Man

6

RASTRELLIGER KANAGURTA (Ruppell)

Its Fishery and Biology

Summary of our Knowledge—Study Programmes

by

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In spite of its small size (it hardly exceeds twenty centimetres) this fish forms the basis of a fishery and an important industry through all the Indo-Pacific region, and for this reason it is worthy of our interest in its biology and movements, because it is a migratory fish.

This short note does not presume to present all known information on this small fish. It is certainly incomplete. Its only aim is to call forth complementary information from different countries of the Indo-Pacific region, for their utilisation in a more developed study of the biology of this fish and a more methodical organisation of its fishery.

POSITION IN NOMENCLATURE

It belongs to the family Scombridae and to the genus Rastrelliger, characterised by the absence of vomerine and palatine teeth and by the length of the gill-rakers which protrude into the buccal cavity.

The synonymy of this species is rather obscure, because local races or individuals of different ages have been described under different names by various authors.

In my opinion, although I have not been able to examine the types, it is reasonable to suppose that the following species are synonymous:

Scomber	kanagurta	Russell	1803
S.	loo	Lesson	1829
S.	microlepidotus	Ruppell	1835
S.	chryzosonus	Ruppell	1838

Like fish of economic interest, it possesses a large number of vernacular names. Following is a list, still incomplete:

Malaya	Kembung-Palata
Indonesia	Kembung-lelaki
Philippines	Alumahan-lumahan
Siam	Pla-thu
Cambodia	Trey Kamong
Cochinchina	Ca bac ma
Annam	
China	
Japan	Gurukun-Murchji

In this note I shall generally use the Siamese name "Pla-thu", which is most often used in Indo-China.

GEOGRAPHICAL DISTRIBUTION

The area of distribution of this species is very great since it extends throughout the tropical zone of the Indo-Pacific region, giving the widest acceptance to this term, such as was used by Fowler for example in "Fishes of Oceania", that is to say from the Red Sea and East Coast of Africa to the West Coast of America.

However, it seems that nowhere is it the basis of a simple and intense a fishery as on the coasts of Malaya, Siam and Cambodia.

BIOLOGY

Coasts of Cambodia and Siam

The Pla-thu appears on the coast of Cambodia towards the end of October in the neighbourhood of the Bay of Kampong-Som; a month later near Cone Island and Kaskapik. It remains there until February, a period when the females are ripe and ready to spawn.

Neither is its fishery continuous. It disappears after a storm, wind or other causes still little known, to reappear when conditions are again favourable.

Its stomach is generally filled with a greenish pulp, probably formed of microscopic algae.

Pla-thu is also caught on the East coast of Siam, but generally rather later than in Cambodia.

On the West coast of Siam and on the Malayan coast, Pla-thu is also present, but according to Dr. H. M. Smith, for a long time Fisheries Adviser to the Siamese Government, it is a different fish there.

On the other hand, from May to July, in the South-West monsoon, large quantities of young Pla-thou, whose length reaches a maximum of 7 centimetres, are seen on the Siamese coast in the vicinity of Koh-Chang and the Bay of Tung-Yai.

The Indies

According to Day (Fishes of India) the eggs are well developed in March, that is to say at the same time as in the Gulf of Siam and it is caught in abundance on the Malabar coast during the cold season.

Japan

According to Kishinouye, it is common in the neighbourhood of the Ryukyu islands, where small individuals are caught in summer and large ones in winter.

In calm periods, schools of these fish can be observed frisking near the surface in shallow water, feeding actively on small planktonic organisms.

FISHING METHODS

On the coasts of Cambodia and Siam, large quantities of Pla-thu are fished during the winter months (November to February) in fixed traps, established on the muddy bottom in depths varying from four to fifteen metres.

These traps comprise a kidney-shaped enclosure measuring 50 m. at its greatest diameter, formed of fixed fences of stakes driven into the mud. This enclosure, which is the capturing chamber, is preceded by another smaller heart-shaped enclosure, towards which converge rows of stakes reaching several hundred metres in length, and whose free end is directed towards the land.

Schools of Pla-thu and other fish meeting these rows of stakes, follow them out towards the sea and thus enter the capture chamber in which they turn round in circles without succeeding in finding the entrance.

Then they only have to be caught.

A barge with a straight net enters the chamber; one end of the net is fixed to a stake at the side of the entrance, the other end to the front of the barge which makes a complete circuit of the capturing chamber, taking care to pass first across the entrance. During this circuit, the upper rope of the net is maintained on the surface with the aid of floats, whilst the lower rope is kept on the bottom of the water. The fish are thus driven into a more and more reduced space. A running rope is then worked which transforms the straight net into a pocket and the fish are taken on board with the help of scoops. In this way, one trap collects an average of 50 to 80 tons of fish per season.

METHOD OF PREPARATION—ECONOMIC INTEREST

In Cambodia, the remoteness of fishing grounds and the slowness of transport means that the fish cannot be despatched fresh. A few attempts have been made with ice, but without any great success.

The most widespread method of preparation consists of gutting the fish through the gills, leaving it for a few days in a brine of 15 kg. of salt per picul of fish, then letting it dry, preferably in the shade.

Thus prepared, the fish is not much appreciated by Indo-Chinese people, but on the other hand, it is popular for export. Before the war, the Siamese steamer of the Bangkok-Hatien Line came each week into the fishing centres (Kaskapik, Cheko, Ream) and took up the produce in each place. The fish was then re-despatched to Singapore, and from there largely to Java.

During the war, the Siamese steamer, having ceased its service, the Pla-thu was sent directly to Java.

Another method of treatment different from the above, which is much appreciated in Indo-China, consists of arranging the fish in small open-work bamboo baskets and boiling them for a few minutes in large basins of sea-water, supercharged with 5 kg. of salt per 20 litres of water.

Thus prepared, the fish will keep for a fortnight, on condition that it is boiled for a few minutes every two days. It can thus reach the remotest villages in the interior and this method of preparation is tending to become more and more popular.

Finally, a factory was installed a few year ago at Cheko, an important fishing centre and makes pre-

serves of Pla-thu in oil or tomato, similar in flavour to American pilchards.

For dried Pla-thu alone, the export for an average year is estimated at about 3,000 tons.

The demand being always superior to the supply, the production could be greatly increased without risk of sales at a loss.

The simplest solution would obviously be to increase the number of fixed fishing traps, but suitable places being rather limited, the traps would obstruct one another and the yield per trap would diminish.

The consruction of such traps also requires expensive materials and a lot of operatives in a region which is poor in these, and indeed numerous fishermen are retreating before the high renting price, and the number of traps has decreased by 50% between 1940 and 1948.

Also this method of ancestral fishery, although in general giving appreciable results, possesses serious inconveniences. In some years, for causes still unknown, schools of Pla-thu do not approach sufficiently near to the coast to be taken in these fish traps and the catch is nil; now a more complete knowledge of the biology of this fish will doubtless permit fishing further afield with suitable equipment.

STUDY PROGRAMMES

The Oceanographic Institute of Indo-China intends to initiate a study on this question whose programme is briefly as follows:

(1) Determination of the conditions required by these fish in their migration by studying plankton, by analysing the stomach content of the fish, and by observing the temperature and the salinity of surface and deep water.

(2) Tagging of fish—a certain number of fish would be marked on the coast of Cambodia at the end of the fishing season (February for instance). In this the Indo-Pacific Fisheries Council could be of great practical use, because the recovery of these tagged fish would necessitate some international co-operation. The fish tagged in Cambodia could indeed be caught on the coast of Siam or Malaya, or even in India; it would therefore be necessary to organise sufficient publicity in these different countries for the fishermen reporting a tagged fish, or at least the tag with some information (place and date of capture, length of fish) to be assured of receiving a fairly substantial bonus.

(3) Research of the schools of fish by generic equipment Asdic etc. and study of the most suitable fishing equipment for their capture.

7

THE PROBLEMS OF FISH STORAGE AND REFRIGERATION IN SOUTH EAST ASIA

by W. B. Braxton, M. Sc.

The objective of this paper is to review the present condition of the South East Asia fishing industry from a technical and economic view-point and to consider the application of the possible steps of refrigeration development in improving the quantity and quality of fish available to the local population. We will draw more heavily on the information available for Malaya for this purpose since this is somewhat typical of the territory. Although the problems of refrigeration, as applied afloat, on land and in transportation to the major consumption centres, must be covered individually in detail, we shall at this stage restrict our study to the proper refrigeration developments of the first two steps of the process, namely, handling the catch at sea and at the collection centre.

EXISTING CONDITIONS:

Climatic.

The whole territory of South East Asia has the common problem, typified by Malaya, of year-round high temperature and humidity with certain coastal exposures faced with monsoons which regularly limit fishing activities.

In considering refrigeration requirements it must be kept in mind that fish have a temperature approximately 40° warmer in the waters surrounding the South East Asia countries than that in temperate climates. Consequently if no refrigeration is provided, spoilage is greatly accelerated and refrigeration equipment must necessarily be of larger capacity to perform the work required than facilities equipped to operate in temperate water.

Technical.

In most of this area the fishing industry consists of small owners operating relatively small boats, having short range of action and rarely powered.

The great majority of Malayan fishing boats rely for their propulsion on sail augmented or replaced, when necessary, by oars or paddles. Power driven craft are used in the larger ports for fishing or bringing the catch back from kelongs or they may be used in taking local sailing boats to and from the fishing grounds.

Sailing boats range in size from a length of about 12 feet to 45 feet, all having considerable variation in their finish. All of these boats are operated from, and in many cases, in shallow water, frequently requiring beaching at the end of each fishing trip; they are consequently of shallow draft without keels of any appreciable depth. None of the boats are decked, though floor boards are fitted to separate off the bilge and provide a level dry base. The spaces between the ribs and the flooring are generally used for stowing the catch.

Boats differ regionally to allow for physiography and the nature of the fishing grounds. In the North East, the coast consists of long sandy beaches, broken at intervals by estuaries where mangroves occur; rough weather is prevalent even in the calm season; in many instances the fishing grounds lie ten or more miles from land.

As a general rule the fishermen try to get to their fishing grounds with the pre-dawn wind from the land and return with the afternoon wind from the sea.

In the South of the Peninsula and on the West coast the sampan is frequently used since the coasts are less exposed than on the North East and a great proportion of the fishing is done close in-shore, principally with hand lines, cast nets or small nets.

The ports from which most of these craft operate are relatively primitive and rarely provide for a central power system which could be used for driving necessary refrigeration equipment on land.

The existing refrigeration shore facilities, with the exception of a few of the larger cities, are nonexistent and drying and salting of fish is a necessity, since this provides the only method of preserving the food value of the catch. Very little of the catch, beyond that portion used for local consumption in the fishing village, is marketed in a fresh condition.

The character of present fishing operations is one of primary transaction taking place in the smaller fishing villages and the product, which is now dried and salted, is handled by merchants for distribution to the larger cities of the territory.

Economic.

A Study of the average of four officially recorded prices of fish on the Singapore market for 1948 indicates consumer prices per katty of $1.56 for fresh fish compared with $1.18 for the same dried salted fish; if an average of 2½ katties of fresh fish are required to produce 1 katty of dry fish then the equivalent price of salted fish in a fresh form is 47 cents, as compared to $1.56; fishermen thus dispose of their catch at very reduced prices. This low price reduces the fishermen's incentive to increase their catch since the price level of fish to be disposed of in a salted or dried condition provides them with only marginal earnings. The lack of proper central refrigerated handling facilities may thus be an essential factor limiting the size of the catch.

Since neither the supply nor the demand appear as yet near full development, the controlling factor of the size of the catch would appear to be limited mostly by the lack of proper refrigerated collection, handling, storage, transportation and distribution facilities.

Studies of the price of fish during monsoon seasons, at which time the catch may be almost entirely stopped, must be used in the statistical analysis for the planning of the application of refrigeration to the fishing units and afterwards to the larger processing plants which may be required to handle the catch properly at all steps of the distribution process.

Further consideration of the probable effect on the entire social structure of the fishing industry must be contemplated, since in the future, with suitable refrigeration equipment available for the handling of the catch it would appear that the proportion of dried and salted fish would be considerably smaller than fresh fish. We may conclude, as

a basis for establishing refrigeration facilities that an average fishing centre would require immediately central collection facilities suitable to handle not less than 50% of the catch; this figure might increase to over 75% of the catch within a relatively short period. Demand for specially processed fish would probably remain for several generations as the taste for these delicacies has been cultivated over centuries.

The general effect on prices of fish with full use of suitable refrigeration should be to raise that of dried and salted fish as it will not be necessary for the fishermen to dump surplus catch into this form of processing, while that of fresh or frozen fish will decline, since the cost of storage per unit of weight is very reasonable. As the average price earned by the fishermen for their catch increases, a larger quantity of fish would become available to the consumer.

REFRIGERATION APPLICATIONS

Afloat.

The vast majority of these short range fishing boats can readily be equipped with iced bunkers of suitable capacity for the ship size involved.

From the above description of the boats involved it will become obvious that iced bunkers are the only form of refrigeration applications which can be contemplated. Such iced bunkers would permit longer trips than usual practise with the catch arriving at the collection centre in the best of condition.

In the case of the larger sailing boats used for net operations in deep sea, the probable size of bunker would have a carrying capacity of the magnitude of 15 piculs. For the smaller boats used with handlines the size of the bunker would probably not exceed 6 piculs and for sampans would probably not exceed a capacity of 2 piculs.

As previously noted, due to the simplicity of the average fishing boat the only possible application to be applied to the non-powered ships would be ice bunkers supplied with crushed ice in sizes not less than 3/16" so as to prevent excessive caking in the bunker. For the size of bunkers involved and 24 hour trips, the quantity of ice, by weight, will be equal to that of the fish. A bunker to provide for the necessary fish and ice would have a volume of approximately 6—7 cubic feet per picul of fish and could be built for an all in cost in the magnitude of $30 in the case of the 6 picul size.

For powered mother ships the application of a small ship board refrigeration system is recommended as the quantity of ice needed to hold the fish in the freshest condition could be cut down to ratios of 1—3 or even 1—4. Ships equipped with mechanical refrigeration can easily make trips of 10 or more days operation with chilled storage at 30° F. Mother ships for long range fishing including complete freezing and processing plants will not come to be feasible or required until such time as collection centres, refrigerated land transport and distribution have advanced sufficiently.

Icing Facilities

The quantity of ice which will be required at any one fishing port will bear a definite ration to the quantities of fish arrival at such points. We can assume that not less than 50% of the fish handled would be the first step in designing the capacity of such a centre. The size of the plant can also vary due to seasonal variations in the catch. Each ice plant must be located near the water's edge for easy delivery to boats through ice chutes and be provided with a storage room for ice so that the fishing fleet may obtain its requisite ice quantities whenever it is in port. If seasonal variations in the catch occur it will prove advisable to have ice storage rooms of considerable capacity since ice can be manufactured throughout the whole year but may only be drawn for a period of 7 or 8 months. An ice plant in such fishing centres should contemplate a small quantity being used for local purchases not directly connected with the fishing industry.

The land icing facilities should also include a receiving room in which the catch may be sorted and packed in iced crates for future shipment to larger centres or possible preparation for quick freezing and storage if this is economically indicated in the study of the statistics.

It is usually found desirable that the ice be frozen in blocks as this will provide for local sale of the product while a specialised plant could only furnish ice for fish or other food industry. The storage of ice in block form is also more readily handled than in crushed form; The crushing of ice should be performed at the time of loading on board ship.

Storage

The question of whether to store fish in a chilled or frozen condition must be determined from the seasonal character of the catch. Under chilled condition at 30° F the normally recommended storage

period should not exceed two weeks, however, it is known that in practice this time has been lengthened to four weeks without appreciable deterioration. If periods of months elapse with reduced supplies landed at the local collection point then frozen storage will be required including quick freezing so as to obtain a marketable product which would retain its premium value. Under such treatment, storage periods of six months can be easily contemplated. Room temperatures, in order to keep any frozen product in the best of condition, must not exceed 0° F with very small fluctuation in temperatures.

Storage space requirements will vary from 80 to 100 cubic feet of gross space per ton of fish depending on local practises and storage periods.

Freezing

Quick freezing and frozen storage is secondary and only the ultimate step which must be thought of when distribution facilities to inland cities have been fully developed; however planning for this eventuality must be considered from the inception of our study.

Freezing of fish should only be accomplished by "Quick freezing" which in the case of air blast which provides for the simplest arrangements, requires temperatures in the magnitude of -40° F. Storage can be in bulk for with glazing of the product after freezing and reglazing at intervals indicated by service and duration of storage. Freezing in the round will probably be the first method, but as distribution increases the filleting and freezing together with individual packaging in boxes provided with vapour barriers may become indicated. The products otherwise lost in the filleting operation, which may amount to well over half the catch should be used for fish meal, production of fish oils or fertiliser, this step in the industrial development of the fishing industry appears relatively remote except in the largest centres. The costs of equipping such plants are not being covered in this paper as special equipment involved will vary considerably from installation to installation.

TECHNICAL ASPECTS.

The construction of cold storage rooms should be approached with the most careful technique to provide for minimum heat gains and most permanent construction. Chiller space would normally be provided with 4″ of cork walls and 6″ roof; the insulation for freezer space would be 2″ thicker on walls and ceiling. The preferred construction technique in the sizes contemplated is single storey, with full curtain wall construction, whereby the interior structural elements of floor, columns and roof are entirely encased in insulation materials with no structural member passing through this outer covering. Rigid insulation practices must be rigidly applied to ships, land and transportation facilities.

Evaporators for all mechanical installations would be of the modern type providing for de-frosting with warm water; in ice storage rooms standard pipe coils would be suspended from the ceiling; brine spray units should be specified in the case of fish receiving rooms.

In the sizes contemplated in this territory the compressor equipment would be of the usual reciprocating type. Due to the considerable number of small auxiliaries involved the compressors should be driven from electric motors instead of directly connecting them to diesels. Separate Diesel Electric generating facilities should then be provided where required.

This arrangement provides for flexibility in the progressive development of the collection centre from an ice plant to the ultimate quick freezing and storage arrangement including the necessary single and multiple staging providing for the utmost in standby facilities.

INLAND FACILITES

In the case of inland transportation, icing will be used for short hauls, requiring usually one pound of ice for two pounds of fish, cold plates having holdover capacity for longer trips and in the case of very large distribution arrangements mechanical equipment applied to railway waggons or trucks. Each of these problems must be studied individually, keeping in mind, the practical aspects of the individual marketing area.

Distribution of fish to inland centres also require storage plants for holding the periodic receipts of fish from the main fishing centres. Dealers must also be provided with necessary day to day refrigeration facilities. All of these applications are fairly well known and the standard equipment for these purposes can be developed for each specific project.

BUDGET COSTS

The following figures are given for rough purposes of budgeting costs of any specific project. The costs of operation include power at Singapore rates and are based on useful life of the equipment as 20 years, they also include for normal maintenance costs.

BUDGET COSTS EXPRESSED IN STRAITS DOLLARS.

	Per ton capacity	Operating costs + per ton per day
Ice Plant (Per day)	$600	$10
Ice Storage Room	200	.04
Receiving Room (per day)	250	.05
Freezer & accessories (per day)	5000	6
Frozen storage	300	.10
Generating facilities, includes Stand-by (per day)	2500	Include above

+ Exclusive of handling, clerical and supervision labour.

TYPICAL PLANT

The attached diagram and preliminary layout indicates the relationship of a typical plant designed to handle a total daily catch of 30 tons of which 15 tons may be frozen and stored, the remaining 15 tons are sold daily to the local market. In this instance the ice plant is of 20 tons capacity suitable to feed trawlers with mechanical refrigeration facilities and provide ice for inland transportation. The fish storage room has a capacity of 500 tons.

An example of the largest scale projects is the recent contract signed by Bergen Fisheries, Norway for an installation capable of handling frozen fish and other foods at the rate of 82,000 tons per year. This plant has a capacity for freezing 300 tons per day and holding in storage 12,000 tons.

In addition it will produce 200 tons of ice per day and has ice storage capacity of 3,000 tons. The compressors consist of four centrifugal machines of 700 H.P. the total connected load is 3,200 H.P.

The magnitude of a freezing plant of the latter size should not be required at present in any country in South East Asia.

The average handling capacity whether chilled or frozen would appear to run in the magnitude of 5—30 tons per day. The power available to drive the machinery in each instance will become a critical factor at this time.

PLANNING

The steps which will be required for the regular planning of a central collection centre would be:—

1. Collection of the statistics for the fishing port in question giving catch by months, present distribution methods and quantities, long term trends, if available would permit closer approximation.

2. Planning and handling of the distribution under refrigerated methods including arrival at a base quantity to be handled through the refrigerating centre.

3. Development of quantities of ice required, ice storage facilities and chilled fish reception centre flow diagram.

4. Preliminary investigation of possible future need for quick freezing and frozen storage including daily freezing rate and total storage facilities.

5. Detailed layout and flow diagram to meet the eventual ultimate development of the scheme with plans prepared for each stage of the development assuring full integration in the future of the complete installation.

These steps are best developed with the advice of local refrigeration experts since recommendations on practical applications of equipment to the specific problems of each locality will change and individual studies on the spot may usually be necessary.

All of these steps will ensure that no superfluous investment, waste of space or physical arrangement will occur.

8

GENERAL REVIEW OF THE FISH AND FISH CULTURE IN THE CONTINENTAL WATERS OF INDO-CHINA AND THE PROJECTED PROGRAMME OF WORK

by L. Lemasson

The fish production of the inland waters of Indo-China is considerable. Though it has not been possible to collect any statistics, it is estimated that the production is about 250,000 tons fresh products per year. It is therefore superior to the production in marine waters which is estimated at only 160,000 tons.

This important production is due on the one hand to the fact that the hydrographic network is particularly well developed, chiefly in Cambodia and Cochin-China and on the other hand, mostly to the particular conditions of the relief and the water regime.

The delta regions of Tonkin and the greater part of Cochin-China and an important part of Cambodia are formed by low terrain. As a result of a great variation in level to which the water courses are subjected by the alternation of a dry and rainy season, these overflow during the whole of one period of the year and flood considerable areas where fish can find favourable conditions for growth. These conditions are especially favourable when the flooded areas are covered with abundant vegetation, sometimes forming a veritable forest. This happens in Cambodia where there exists a very large lake known as the Great Lake of Cambodia, and which is surrounded by forests. The Great Lake, which covers a superficies of 3000 km.^{2} during low waters, is invaded by the waters of the Mekhong during the rainy season. It trebles then its area and floods the surrounding forests where fish can find such remarkable conditions for development that the production of the lake is about 50,000 t. per year.

This particular situation of the fresh waters of Indo-China led Krempf to formulate the following conclusion more than 20 years ago:

> "The more the study of fisheries develops in Tropical regions, the greater is the evidence of the biological superiority of freshwaters over marine waters. When this freshwater is helped in its biological action by its customary complement normal in the tropics, the flooded forests, there is in the hot zone a real inversion of the relative value from the ichthyological point of view of sea water and freshwater."

But the eminently favourable conditions, offered by the division of inland waters of Indo-China to important piscicultural production, have been greatly modified by the evolution of the country and its economic development during the past fifty years. We have said that these favourable conditions resulted especially from the periodic flooding of vast areas continually covered with abundant vegetation but the development of cultivation and the hydraulic control of the deltas have caused a considerable decrease in these areas. The area cultivated with rice in Cochin-China for example increased from 500,000 hect. in 1880 to 2,200,000 hect. in 1939. In Cambodia about 250,000 hect. of flooded jungles and forests were cleared between 1929 and 1938 for maize cultivation.

The maintenance of the annual productivity requires special measures, the study of which has been arranged.

Exploitation of the Fisheries

Fisheries are being exploited strictly on a familial and artisanal basis in Tonkin, Annam and Laos; industrial fishing is found as well in Cochin-China and especially in Cambodia it has given place to undertakings of industrial character, taking account of the importance of capital and labour which they need.

It is these undertakings which concern us here, first because of their importance, secondly because they are the most likely to respond to an action for improvement of economic efficiency.

They employ three main methods of fishing*.

(1) Fishing with nets which are most often of the "seine" type and are usually several kilometres long.

* These methods of fishing as well as all those employed in the familial and artisanal fisheries are described in detail in the work of Messieurs Chevey and Le Poulain "The Fishery in the Fresh Waters of Cambodia" (Saigon, 1940)

(2) Fishing with barrages, fitted with various catching devices and placed when the waters are receding, in a manner to bar the whole width of the river through which the flooded areas empty when the waters recede.

(3) Fishing with "samras" which consists in creating by immersion of branches, a sort of artificial forest under which the fish will find refuge when the waters are going down and which will be surrounded with a screen. These screens are progressively shifted in order to bring the fish into a capture chamber.

Industrial fishing is carried out either in regions where fishing rights are farmed out by the State as proprietor of the region, and which are divided into shares sold by auction, or in regions where fishing is free provided that taxes on fishing equipment used are paid.

The price of the renting of the shares is sometimes very high. It is over $200,000 per year for some lots. Moreover, the capital necessary to the exploitation of the fisheries, which varies with the importance of the fishing gears used, is usually high.

As an example, a fishing operation using a net on the Great Lake in Cambodia with a net 5 km. long and 2.50 m. high requires actually a capital of $130,000. Since the fisherman himself does not usually have the necessary capital, he is then obliged to borrow and under very onerous conditions. Another consequence of this is that he gets only a small part of the profits made by the exploitation, the bigger part of these profits going to the usurer.

The organisation of a normal financing of the fisheries and the elimination of middle-men who take advantage of the poverty of the fishermen, are the most important improvements to be brought about in the fisheries. It influences most of the others.

FISH CULTURE

It is chiefly in the north of Indo-China that fish culture is of some importance as much for its development as for the technical methods used. This is due largely to the fact that the efficiency in the waters is less than in Cambodia or Cochin-China and that the population has been able to imitate the fish culture methods used in the South of China since time immemorial.

In the North of Indo-China, two sorts of fish culture exist, the fish culture used by the Vietnamese in the delta regions and the fish culture used by the Thais, who form the population of the biggest part of the mountainous regions of Tonkin.

The Vietnamese fish culture, which has taken its inspiration from the Chinese, is unusual in the respect that the fry necessary to the breeding are collected in the rivers as soon as they are born.

The fry are cared for by specialists before being used for the stocking of the ponds. Most of the time, several species are reared in association; the main ones are in order:—

Hypophthalmichthys Harmandi, Sauvage

Cyprinus carpio, Linne

Labeo collaris, Nichols and Pope

Mylopharyngodon aethiops, Basilewsky

The fish culture by the Thais is totally different. It only concerns one species the carp (*Cyprinus carpio*) and is in use in the rice fields rising in tiers on the hillsides and supplied with water by the springs and the small brooks. The fish culture is done either in alternation or jointly with rice culture and lasts from two to five months. In order to obtain the fry which is necessary, the pisciculturist either engages in artificial propagation or collects from the rivers nearby the eggs which have just been laid.

The service of Piscicultural Research has perfected in 1942 the methods of application for this fish-culture in the rice-fields of the deltas in Tonkin where the natural conditions are far less favourable than in the mountainous regions.

In Cochin-China and in Cambodia, pisciculture has increased moderately for the past ten years. It is still very primitive and consists only in putting in the ponds of small size, fish of various sizes coming from the fishing in the rivers. They are usually fed artificially and they are caught when they have reached a reasonable size. The species most often bred in this way are:

Pangasius sutchi, Fowler

Ophiocephalus striatus, Bl.

Trichopodus trichopterus, Pall.

PRODUCTS OF THE INLAND WATERS

We can estimate that the Chinese pisciculture used to supply before the war 10,000 tons of fish.

The fish supplied by the inland waters are being used in various ways. The main ones are: fresh fish, dried fish, fish oils, manure, nuoc-man, and various fish pastes.

The quantity of fish eaten fresh before the war was 100,000 t. per year. This tonnage has been increased these last years to the detriment of the salted dry fish, as it is actually far more advantageous for the fisherman who can do so, to sell the catch when fresh rather than dry. Fresh fish is carried in "live-fish boats" over long distances. It is thus that the markets of Saigon are partially supplied with the fresh fish of Cambodia. There does not exist at the moment in Indo-China any organisation making possible the use of refrigeration for the storage and transport of the fish.

Dried Fish. A part of the catch is dried after salting. The only drying method used is drying in the sun. It is difficult to appreciate the quantity of dry fish eaten on the spot, but before the war, 25,000 t. of it were exported each year, out of this 20,000 t. to Indonesia. These exports stopped during the war, and have been resumed on only a small scale, since 1945 and were still in the neighbourhood of 2,000 t. from 1946, 1947 and 1948.

Fish Oils. These are made either with whole small fish or with the guts and heads from the production of dried fish. The process employed, which consists of boiling the fish in water in a cast iron kettle and collecting, after cooling, the oil risen on the surface, is very primitive and only a part of the oil contained in the fresh fish is thus extracted. Moreover, the oil delivered to the trade is very often of a poor quality containing a high percentage of water and many impurities.

The annual production is about 4,500 t., 2,000 t. of which are exported to France.

Manure. The by-products of oil manufacture having been more or less ferments are sometimes used as manure. In the same way, at certain times and certain years, there are shoals of small fish so important that the means at the disposal of the fishermen do not permit them to be used either for production of dried fish or for production of oil. The fish is then put to dry in the sun on the banks and is sold as manure. This manure is of a poor quality, since during the fermentation they have lost a great percentage of their azote in the atmosphere without any benefit.

"Nuoc Mam". The "Nuoc Mam" is as we know an "autolysat" of fish having gone through specific fermentation. It is the national Vietnamese condiment.

Its production from fresh water fish, which formerly had only small importance, has increased considerably during the war. Important factories of "nuoc mam" have been put up in Cochin China and Cambodia and the production of "nuoc mam" from fresh water fish was about 5 million litres in 1944. Actually as a consequence of the situation in Cochin China, many factories have stopped or are working slowly; on the other hand, in Cambodia, production has increased.

Unfortunately, the "nuoc mam" of freshwater fish made in Cambodia, is of a very poor quality. It contains only a very inferior quantity of nitrogen compared with what is required by the existing regulation.

Various fish pastes. There are many varieties obtained by the planned fermentation of all kinds of fish. The most important is the "Prahoe", national condiment in Cambodia and this paste is made of fermented and pounded fish.

Programme of the Projected work

The Hunting and Fisheries Service of Indo-China created a year ago has set up and started to carry into effect a programme of survey aimed at maintenance and improvement of the yield of the inland waters.

This work will fall into four categories:

Work concerning the maintenance and the improvement of the productivity of the waters.

Work concerning fishing exploitation.

Work concerning the rational utilisation of the fishing products.

Work concerning fish culture.

1. Work concerning the maintenance and the improvement of the productivity of the waters.

This work shall:

(a) determine the optimum conditions of life of the economically interesting species of fish. The species, the study of which will be undertaken first, are:

Pangasius sutchi, Fowler.

Ophiocephalus striatus, Bl.

Ophiocephalus maculatus, C & V.

Thynnichthys thynnoides, Blkr.

Pseudosciaena soldado, Lacep.

(b) to establish in what measures these optimum conditions are released in the various piscicultural zones; the first zone to be studied will be the one including the Great Lake of Cambodia and its "defluent" towards the Mekong.

(c) to determine the measures to be taken or the work to execute in order to create or maintain in these zones conditions of life for the fish as near as possible to optimum conditions.

2. Work concerning fishing exploitation.

The improvements to be brought about in the fishing exploitation are of two kinds:

Some are of a technical character, the others of social character.

For the amelioration of technical character, two series of projects are envisaged.

(a) the study of the financial condition of the fishing undertakings and the possible means of enabling the fishermen to escape from the grasp of the usual usurer.

(b) the study of a better organisation of the shares for sale by auction, in order to get a more appropriate division of the shares. Actually their importance and consequently the price of their rent is such that most often they can only be rented by people who own important capital; these people very often are not fishermen but sublet them afterwards, having shared them among the real operators, thus receiving substantial profits. A better organisation of the shares would permit the elimination of these middlemen.

(c) the study of labour problems which are met in industrial fishing and the possibilities of improvement of the standard of living on the fisheries.

3. Work concerning the rational utilisation of fishing materials.

These surveys relate chiefly to the following points:

(a) improvement in the preservation and the conditioning of dry fish.

(b) improvement in the quality of the oil delivered to the trade and determination of the types of standard quality.

(c) recovery of the by-products of oil manufacture and salted dry fish and of the small fish as well, having no other use, for the manufacture of fish meal as food for cattle.

(d) determination of the optimum conditions of manufacture of "nuoc mam" from the freshwater fish and of quality equal to the "nuoc man" from marine fish.

4. Survey concerning pisciculture.

It has been decided for the time being not to go any further than the diffusion of the breeding techniques already fixed, particularly in fish culture in the rice fields.

9

AN OUTLINE OF A PRELIMINARY SURVEY INTO THE SOCIO-ECONOMICS OF THE FISHING INDUSTRY OF HONG KONG

by J. Cater

1. In taking stock of the industry immediately after the re-occupation of the Colony, it was apparent that the most important problems were still economic and social. The great potentialities of the industry were recognised and it was realised that if a planned economy, on an owner-operative basis, were to be effected, firm, even drastic, action was required.

2. The system of marketing had for long been recognised as the basic ill of the industry. Whilst the industry remained in the hands of a few large wholesalers (laans), further development was not possible. In the pre-war years the laans had gained control of the industry by financing the improvident fishermen. When loans were made to the fishermen no contract was signed and interest was seldom

charged. The only condition of the loan was that the fisherman should market his fish catch through the laan. In this way the laan made sure that any profits to be made in the industry went either to him or his subordinates. The fisherman, in the main, was kept at a bare subsistence level and seldom did he have sufficient funds to enable him to experiment with new gear and methods.

3. The action taken by the Hong Kong Government has been described elsewhere (in the Department's Annual Report and the paper presented to the Singapore Fisheries Meeting in January, 1947), but, briefly, a Government Marketing Organisation was formed to take over completely the activities of the laans. The organisation had as its first aims a fair return to the fisherman for his labours and a reasonable price to the consumer. Two wholesale markets were established in the main centres and collecting centres were started in the fishing villages. These collecting centres had as their main function the collection and transportation of fish to the Markets, but they also acted as distribution centres where essential foodstuffs and gear were retailed to fishermen at the lowest possible prices. They also served as social welfare centres where fishermen could obtain advice on the many and varied problems which face them in their everyday life. An educational programme was formulated in which Discussion Groups and primary schools were started in the main fishing villages and, on the island of Hong Kong, a Senior Fisheries Class was established in which students were taught fisheries, navigation, meteorology and other allied subjects. In two villages medical clinics have been opened for the exclusive use of the fishermen. A Loan and Savings scheme has been started and, to date, over H.K. $650,000 has been lent to fishermen. With the advice of the Fisheries Department both consumer and producer cooperatives have been started by small groups of the fishermen.

4. The Hong Kong fisherman is both skilful and courageous. It is recognised that the next step in development must be in the mechanisation of the industry. The Department is fully aware of the possible effects that this modernisation may have on the local fishing population, especially with regard to the unemployment problem. Before embarking on any mechanisation programme, it was considered essential to carry out survey of the economic and social factors of the industry, in order that the effects of the impact of any mechanisation on the industry may be known, so that the degree of modernisation in the early stages could be determined and, later on, how any surplus population could be utilised in a planned economy of the industry in secondary industries such as fish canning and smoking, net-making and so forth. In other words, before further development could be planned it was necessary to have a deep understanding of the structure and organisation of the industry, especially with regard to the ability, training, habits and superstitions of the fishermen; the status of employees and their relationship with their employers; the finances of the industry and ownership of capital equipment.

5. The existence of the Marketing Organisation, with its collecting centres in the main fishing villages, and the compactness of the territory made the carrying out of such a survey in Hong Kong comparatively easy. Based on the "Programme of socio-economic research into the Fisheries of South East Asia", submitted by Dr. G. L. Kesteven to the October Liaison Officers' Meeting, a preliminary survey was started in December, 1948. A preliminary survey based on a quota sample basis was decided upon as it was desirable that experience be obtained and possible pit-falls be known before atttempting the more extensive survey which is now under consideration.

6. Many statistics required for the descriptive phase were available from the records maintained by the marketing organisation, but details as to locality of catch, wages, finance, determination of unit effort and so forth were lacking. Description and statistics of distribution elements were available mainly from the marketing organisation records and with little research, it was possible to obtain fairly reliable data. Little had been recorded regarding units of organisation. In addition it was realised that, for our purposes, the study of the fisherman's history, customs and superstitions was also essential.

7. Representatives from the collecting centres of the marketing organisation were given detailed instructions as to what was required in the survey and the method of approach for the collection of statistics and factors. These men were well-known to the fishermen for they had, over the past three years, been working with and for the fishermen. Even so, instructions were given that when information was being obtained from the fishermen the official manner and pencil and paper should be replaced by a friendly manner and a good memory.

8. The sections for study and investigation divided themselves naturally into the technical groups of different classes of boats and equipment. The first important task was the selection of subjects of study within these groups on a quota sample basis. Great care and much time were spent on these selections. Various factors, including standard

of education, degree of poverty, race, religion and so forth were taken into consideration. Care was taken not to select from only those fishermen who would be keen to give information or who were known supporters of the Marketing Organisation.

9. The marketing organisation acts as the Government agent for the distribution of rationed goods to the fisherfolk. A fairly accurate record of the numbers of junks and fishermen is maintained for purposes of rationing. (See Appendix). The selection of groups for investigation was based on this record. Different classes of boats tend to congregate in different villages, thus we have long-line fishermen operating mainly from Shaukiwan on Hong Kong Island, trawler fishermen from Cheung Chan Island and so forth. Investigation of the groups was assigned, therefore, to the centres on which were based the greater number of different types of vessels. Classes of boats and fishermen selected for investigation were:—

Purse seiners

Shrimp trawlers,

Hand liners

Ku peng,

Big-tail junks,

Pa teng,

Trawlers (deep-sea),

Trawlers (in-shore),

Long liners (Large),

Long liners (Medium size).

The minimum number selected for investigation in each class was 12.

10. The investigators were instructed to find out literally everything possible, socially and economically, concerning the subject of their investigation. Detailed pro formas were drawn up on which was to be shown *inter alia* data as to production, income, expenditure, organisations, relationship. *Production* was to show amount of catch, area in which caught, men engaged, type and design of boat and gear, times net or lines shot and so on; *income* was to be taken as the gross money income or the total price offered for the fish catch at the Market—net money would be calculated as gross income less production costs and real income was to be considered in terms of goods, services, supplies and so forth which the money income could purchase; *expenditure* was to include production, marketing and distribution costs and other expenditure on services, luxury goods and so forth not connected with production and marketing; *organisations* of all types were to include the family as a fishing unit, co-operative societies, guilds and so on; *relationships* were to be taken as those between the various factors investigated, not only to give a general picture of the organisation of the industry, but also for the effect on movement of supplies and price levels.

11. It is too early to attempt to give any details or indications as to socio-economic factors, for the nature of the investigation is such that uniform, systematic enquiries are not possible—or desirable—with the conservative and highly suspicious fisherman. Sufficient concrete facts to enable the writing of a report are not expected to be available for some two to three months to come.

12. In order to obtain a background, it was considered desirable to study—if possible—the early history of the fisherman. Surprisingly little is known—certainly not much has been written—of the Hong Kong fisherman and his antecedents. The fisherman's account of his history, although valuable, is too often shrouded in mysticism and folk-lore to be taken as completely reliable, and only fleeting mention is made of Hong Kong fishermen in the Topography. In the main we are indebted to S.F. Balfour's "Hong Kong before the British" for the following facts.

13. The peasant population of Hong Kong consists of four distinct communities known as Tan ka, Hoklo, Punti and Hakka.

14. The Tan ka and the Hoklo are the fishermen of the region. They are thought to be non-Chinese in origin, whereas the farmers, the Punti and Hakka, claim to be of pure Chinese stock. It is known that the Tan ka were in the Hong Kong area well over 300 years before the first Chinese peasants began to migrate into the region during the Sung dynasty (A.D. 960). Although possibly of non-Chinese origin, the Tan ka and Hoklo fishermen have been so overwhelmed with Chinese culture that little remains of their original customs.

15. The Tan ka, for the most part, live in boats. They support themselves almost entirely by fishing or in subsidiary industries such as net and rope-making. Very rarely does a Tan ka live on-shore. He is no architect and the nearest he comes to living on-shore is in an unseaworthy vessel that has been pulled up on the beach and is used as a dwelling. A typical house-boat community is to be found at Tai O in the South Western part of the Colony. The

Tan ka boats, however, are extremely well made and were probably evolved as a result of contact with the foreign people, even as late as the Portuguese.

16. The Hoklo are to be found mostly in the North Eastern region around Mirs Bay. The boats are not so well constructed as those of the Tan ka, and the Hoklo very often lives on land in small mat-shed villages.

17. The Tan ka and Hoklo, then, must be considered as communities apart from the land-dwellers. This is reflected in their obvious dislike of sharing the same schools, medical clinics and so forth. Although it may be desirable that the fishermen and land dwellers mix as much as possible, it has been necessary to provide schools for the fishing population alone and a start has been made in two villages to give the fishermen a medical clinic of their own.

18. The Tan ka practice of living on their boats is likely to have its effects on any attempt at modernisation, especially of the shape of the vessels. Up to the present, the programme of modernisation in Hong Kong is still in the experimental stage and only a few existing vessels have been mechanised. But already one can see that junk-masters are reluctant to consider a changeover to a vessel of modern lines. This no doubt is mainly on account of the fishermen's natural conservatism, but certainly it is partly due to the Tan ka's practice of having his entire family, of up to 30/40 people, and household, down to dogs, pigs and chickens, on board boat—a practical impossibility on a single sized boat of modern design.

APPENDIX.

NUMBER AND DIFFERENT TYPES OF JUNKS IN THE COLONY.

(Based on registration for supply of Government rationed goods).

Kind of Junk.	*Number.*
Purse Seiner	1,492
Shrimp Trawler	450
Hand Liner	1,217
Ku Peng	103
Big Tail	539
Pa Teng	73
Long Liner (large)	45
Long Liner (medium)	125
Trawlers	656
Miscellaneous (including fish collecting junks)	171

10

THE ECONOMIC MARINE ALGAE OF MALAYSIA AND THEIR APPLICATIONS

by

J. S. ZANEVELD*

"Indeed the seaweeds are not finding repose in this generation for day by day the scientists and industrial workers are developing new uses for them in every walk of life."

FLORENCE MEIER CHASE
(in Ann. Rep. Smiths. Inst. 1941 (1942) *p* 451)

INTRODUCTION:—From ancient times till the beginning of the XVIIIth century the Occidental and Oriental peoples differed largely in opinion with regard to the importance of marine algae. Whereas the Greek and Romans spoke about "dejecta vilior algae", the Orientals, already in the time of Confucius, considered seaweeds a food of great delicacy. Especially the Chinese, the Japanese, the Philipinos,

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and the Hawaiians are known as phycophages. Moreover, in the East algae are used not only as food but also for many other purposes.

After 1800 the industrially-minded Westerners changed their opinion and in several countries exposed to the Atlantic a seaweed industry was started and became prosperous especially in the XXth century. As a result of this the literature on the economic applications of marine algae increased considerably in the last forty years. "Indeed", and I agree fully with Miss Chase's words quoted at the top of this paper, "the seaweeds are not finding repose in this generation".

However, a review of the seaweeds used in the islands of the Malay Archipelago does not exist, although Burkill in his invaluable book on the Economic Products of the Malay Peninsula (1935 [1]) did not restrict himself to the peninsula proper in his remarks on the utilization of algae.

On account of this, the present author intends to give in this series of papers a survey of the marine algae economically used in the Malay Archipelago. Moreover, it seemed advisable to extend this investigation beyond Indonesia to adjacent countries and to take into consideration also the Philippine Islands and the Malay Peninsula.

This vast region covered may be indicated by the term Malaysia, cf. Lam, (1937[2]); Van Steenis, (1937[3]), Zaneveld, (1940[4]).

In order to make the present survey more easily accessible to non-botanists, the genera and species are not arranged taxonomically, but alphabetically. In the first part (the present paper) the Cyanophyta and Chlorophyta are treated, whereas the second part will summarize the Phaeophyta, and finally the third part will deal with the Rhodophyta besides closing with a bibliographic list.

The literature mentioned for the individual species and varieties concerns only the original description, the place where the recombination of the specific epithet was introduced, and the publications dealing with the economic application of the species involved. Not included are references to purely taxonomic and ecological matters.

The classification of the blue and green seaweeds here enumerated is, in accordance with Fritsch (1935 [5]), as follows:

Division	Order	Family	Genus
CYANOPHYTA (MYXOPHYCOPHYTA).	Nostocales	Nostocaceae	*Nostoc*
CHLOROPHYTA	Ulotrichales	Ulvaceae	*Enteromorpha*
	"	"	*Ulva*
	Cladophorales	Cladophoraceae	*Chaetomorpha*
	Siphonales	Dasycladaceae	*Acetabularia*
	"	Codiaceae	*Codium*

The number of marine algae used in one way or another in Malaysia is undoubtedly much greater than would be gathered from the present paper. For instance, this is due to the lack of references in literature to the many species utilized in Japan, China, the Mid-Pacific Islands and Australia and also occurring in the region under consideration, rather than to these species not being used. In addition, the identification of the species mentioned in literature could not be verified, so that perhaps more species of a genus are of economic importance than have been cited.

Therefore, it is desirable that taxonomic investigations, the background for all scientific and industrial biological work, be continued and promoted.

Nevertheless, it should be remarked that the utilization of marine algae as human food, particularly in the Malay Peninsula and in Indonesia, seems nowadays by no means as general as one would suppose, when reading the earlier authors like Rumphius and Von Martens.

CYANOPHYTA (MYXOPHYCOPHYTA)

Note: A careful study was made by Suringar of the use in Japan of an edible Cyanophyte not listed below, viz. *Phylloderma sacrum* Suring; cf. Okamura (1933[6]). Some items may be recapitulated here as the alga probably occurs in Malaysia too. The plants are gathered from the natural growing places and thoroughly washed with water. All epiphytes and other adhering matter are removed with pincers and then the weed is chopped up. After that, the mass is crushed and made into a paste by kneading it with a trowel. Then this paste is spread over unglazed tiles in the sun. When dry it is peeled off the tiles in thin paper-like sheets. For use, these sheets are cut into small strips and soaked in water until they swell up, when they are ready for use.

As I was informed by Mr. W. H. Schuster, Adviser on Fisheries, Batavia, the vernacular name "keklap" is used by the Javanese people to indicate the free floating Cyanophyte colonies. These colonies mainly consist of *Oscillatoria* species, but *Nostoc* species are sometimes also extant. The colonies incl. the detritus are eaten by fishes.

Nostoc VAUCHER

(*Order*: Nostocales. *Fam.*: Nostocaceae)

The dense thallus is composed of numerous intertwined, contorted filaments with thin walls and a thick, gelatinous sheath. Gelatinous thallus extremely variable as to size and shape, solid or hollow, floating free or attached. Growing in sea, brackish, and fresh water, or on surface of damp soils.

Note: A fair amount of proteids is present in *Nostoc* species: cf. Burkill (1935) p. 1561 (*l.c.*).

Nostoc commune VAUCHER

Vernacular name: djamur batu (Java).

Literature: VAUCHER Hist. Conf. d'eau douce (1803) 822.—BORNET et FLAHAULT *in* Ann. Sc. Nat. Bot.,/ser. 7, 4 (1887) 203.—BK *in* Trop. Natuur 3 (1914) 156 (no species mentioned; "blue weeds" only).—BURKILL Ec. Prod. Mal. Pen. 2 (1935) 1561.

Distribution: Cosmopolitan.

Use: According to a note on a label of a specimen extant in the Leiden Herbarium it is sometimes eaten in Java. 7)

Okamura (1933) and Burkill (*l.c.*) both mention that the species is frequently eaten by the Japanese and the Chinese. The Chinese use seaweed-jelly made from several species of *Nostoc* or fah-tsai.

CHLOROPHYTA

Acetabularia LAMOUROUX.

(*Order*: Siphonocladiales. *Fam.*: Dasycladaceae)

A genus of lime-encrusted plants confined to warm waters. The algae have the appearance of a slender toadstool, consisting of an erect axis bearing one or more whorls of forked, sterile laterals with a single fertile whorl at the apex. The delicate plants are seldom over a few cm high. Growing in shallow waters of the littoral region where the plants are anchored on stones, rocks, etc. by means of richly branched rhizoids.

Acetabularia major Von Martens.

Vernacular name: gembur batu; kedji; kedji beling; ketjibling; petjah beling (all Javanese and Sundanese names).

Literature: VON MARTENS Die Tange (1886) 25, pl. 4. f. 3.—BOORSMA Jav. Geneesm. (1906) 54; Oost Geneesm. (1913) 39.—BEUMEE *in* Trop. Nat. 14 (1925) 15, 16.—HEYNE Nutt. Pl. Nederl. Indie, 2nd ed., (1927) 36.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 28.

Distribution: Philippines. Indonesia: Java (Djapara).—Pacific: Japan, Siam.

Use: The species is used on the north coast of Java as a remedy for gallstone, renal calculi, and stones in the bladder. This is probably due to the capability of the rhizoids to secret acids (Boorsma 1913, *l. c.*).

An annotation given on the label of a specimen extant in the Buitenzorg Herbarium mentions that after chewing the alga for two minutes a piece of glass was completely masticated without any damage to the mouth and tongue. Cf. also Beumee (*l. c.*).

BURKILL (*l. c.*) also remarks: "There is no reason to regard it as of value. Its employment is by homoeopathic magic."

Caulerpa LAMOUROUX.

(*Order*: Siphonales. *Fam.*: Caulerpaceae)

The colourless rhizomes are attached to sand or to dead pieces of coral by means of colourless rhi-

zoids. The rhizomes give rise to a great number of green shoots, which are simple and phylloids, or exhibit axis bearing ramuli of various shapes. A large, widely distributed genus in the tropics. Most of the species occur in the shallow water of the littoral region below low tide level (baso- and semi-littoral belt; cf. (1937 [9]), preferably in lagoons protected by coral reefs.

Note: According to Okamura (1933 [10]) the plants of *Caulerpa* are not dried but preserved in salt when used for human food.

Caulerpa peltata (Lamouroux) Weber-van Bosse

var. *macrodisca* (Decaisne) Weber-van Bosse

Vernacular name: lata (Bangka).

Literature: LAMOUROUX *in* J. de Bot., Paris 2 (1809) 145, pl. 17, 3, f. 2.—DECAISNE *in* Ann. Sc. Nat, 2, Bot. 17 (1842) 336 (sub. nom. *Chauvinia macrodisca*).—WEBER-VAN BOSSE *in* Ann. Jard. Bot. Buitenzorg 15 (1898) 376.—HOFSTEDE *in* Alg. Landb. Weekbl. Nederl. Indie 8 (1923) 319.—COLLADO *in* Philipp. Agr. 15 (1926) 129.—HEYNE Nutt. Pl. Nederl. Indie, 2nd. ed., 1 (1927) 35.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 498.

Distribution: Philippines. Indonesia: Bangka, Celebes (near Makassar), Postiljon I., Djedan I.—Pacific: Polynesia.

Use: This variety is eaten in Bangka. In Luzon (Ilocos and Cagayan Provinces) it is used raw as a salad.

Caulerpa racemosa (Forskal) Weber-van Bosse

Vernacular name: lelato (Lombok).

Literature: FORSKAL Fl. Aeg.-Arab. (1775) 191 (sub nom. *Fucus racemosus*).—WEBER-VAN BOSSE *in* Ann. Jard. Bot. Buitenz. 15 (1898) 357; *in* De Zeeen Nederl. Oorst Indie (1922) 264 [11].—VORDERMAN; cf. HEYNE Nutt. Pl. Nederl. Indie, 2nd ed., 1 (1927) 35.—RIDLEY *in* Proc. Linn. Soc., Lond. f. 1929-'30 (1930) 35.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 498.

Distribution: Malay Peninsula. Philippines. Indonesia: widely distributed.—Atlantic, incl. Mediterranean; Indian Ocean; Pacific Ocean.

Use: Quite edible, of a rather pleasant taste. Especially eaten in eastern Malaysia.

Caulerpa racemosa var. *clavifera* (Turner) Weber-van Bosse

Vernacular name: lai-lai (Ternate: Tawali-ketjil).

Literature: TURNER Hist. Fuc. (1808-1811) pl. 57 (sub. nom. *Fucus clavifer*).—WEBER-VAN BOSSE *in* Ann. Jard. Bot. Buitenzorg 15 (1898) 361.—VON MARTENS Die Tange (1866) 141 (sub nom. *Chauvinia macrophysa*).—HOFSTEDE *in* Alg. Landb. Weekbl. Nederl. Indie 8 (1923) 319.—HEYNE Nutt. Pl. Nederl. Indie, 2nd ed., 1 (1927) 35.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 498.

Distribution: Malay Peninsula. Indonesia: widely distributed.—Atlantic, excluding Mediterranean; Indian Ocean; Pacific Ocean.

Use: According to Von Martens the plants are eaten as a desert after a rice meal.

In Makassar (Celebes) the variety is sold in the native market. It is used both raw and cooked.

It is also eaten in the island of Guam (Safford (1905 [12]) 117).

Caulerpa racemosa var. *laetevirens* (Montagne) Weber-van Bosse

Vernacular name: bulung buni (S. Bali).

Literature: MONTAGNE Voy. Pole Sud (1842-1845) 16, pl. 6, f. 1, (sub nom. C. *laetevirens*).—WEBER-VAN BOSSE *in* Ann. Jard. Bot. Buitenzorg 15 (1898) 366.—HOFSTEDE *in* Alg. Landb. Weekbl. Nederl. Indie 8 (1923) 319.—HEYNE Nutt. Pl. Nederl. Indie, 2nd ed., 1 (1927) 35.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 498.

Distribution: Philippines. Indonesia: S. Bali, Ceram-Laut Is., Kei Is., Damar Is.—Atlantic: West Indies; Indian Ocean; Ceylon; Pacific Ocean; Friendly Is.; Australia.

Use: This variety is eaten in Southern Bali.

Caulerpa racemosa var. *uvifera* (Turner) Weber-Van Bosse

Vernacular name: ar-arusip (Philippines: Luzon (Ilocos Prov.)).

Literature: TURNER Hist. Fuc. (1808-1811) pl. 230 (sub nom. *Fucus uvifer*).—WEBER-VAN

BOSSE *in* Ann. Jard. Bot. Buitenzorg 15 (1898) 362.—COLLADO *in* Philipp. Agr. 15 (1926) 129.

Distribution: Philippines: Luzon (Ilocos and Cagayan Prov.). Indonesia: Celebes, Buru, Rotti Is.—Atlantic: Atlantic coast of America, West Indies; Indian Ocean: Ceylon, Red Sea; Pacific Ocean: Japan, Australia.

Use: The variety is eaten raw as a salad.

Caulerpa serrulata (Forskal) J. Agardh

Vernacular name: galgalacgac (Philippines: Luzon (Ilocos Prov.)).

Literature: FORSKAL Fl. Aeg. Arab. (1775) 188 (sub. nom. *Fucus serrulatus*).—C. A. AGARDH Sp. Alg. 1, 2 (1822) 446 (sub. nom. *Caulerpa Freycinetii*).—J. G. AGARDH Alg. Ruppell (1836) 174.—VON MARTENS Die Tange (1866) 24, 63. COLLADO *in* Philipp. Agr. 15 (1926) 129.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 498.

Distribution: Singapore. Philippines: Luzon (Ilocos Prov.) Indonesia: Tikus I. (W. coast of Sumatra), E. coast of Borneo, Celebes, Timor, Moluccas, New Guinea.—All tropical seas.

Use: The species is eaten in Singapore.

Caulerpa sertularioides (Gemelin) Howe

Vernacular name: salsalamagni (Philippines: Luzon (Ilocos Prov.)).

Literature: GMELIN Hist. Fuc. (1768) 154, pl. 15, f. 4 (sub nom. *Fucus sertularioides*).—HOWE *in* Bull. Torrey Bot. Cl. 32 (1905) 576.—COLLADO *in* Philipp. Agr. 15 (1926) 129.

Distribution: Philippines. Indonesia: widely distributed.—In all tropical seas.

Use: The species is eaten raw as a salad.

Chaetomorpha KUETZING

(*Order* Cladophorales. *Fams* Cladophoracea)

The plants are composed of unbranched filaments, which sometimes fasten themselves by means of more or less branched rhizoids; in other species, however, they are not attached at all, the filaments being twisted together forming intricate clumps, resting on stones or other algae. The genus is found both in the sea and in brackish water all over the world. Mainly attached to rocks in the littoral zone (ultra-littoral belt).

Note: The arrangement of this genus in the order Cladophorales is in accordance with Fritsch (1935 [18]). More frequently it is placed to the order Siphonocladiales.

Chaetomorpha antennina (Bory) Kuetzing

Literature: BORY DE St VINCENT ex MONTAGNE Voy. Pole Sud. (1842-1845) 4 (sub nom. *Conferva antennina*).—KUETZING Spec. Alg. (1849) 379.

Note: C. antennina occurs in Malaysia but it is not known if it is eaten in this region though this is probably the case. In Hawaii and Maui (Reed, (1907 [14]) the species is indeed eaten and known under the vernacular names: limu huluilio, limu ilic or limu mami. This means "dog's hair".

Chaetomorpha crassa (C. Agardh) Kuetzing

Vernacular name: kauat-kauat (Philippines: Luzon (Union Prov.); ririppus (Philippines: Luzon (Ilocos Prov.).

Literature: C. A. AGARDH Syst. Alg. (1824) 99 (sub nom. *Conferva crassa*).—KUETZING Spec. Alg. (1849) 379.—SEALE *in* Philipp. J. Sci., D, 6 (1911) 309.—WESTER *in* Dept. Agr. Nat. Res., Philipp. Is. Bull. 39 (1924) 21.—COLLADO *in* Philipp. Agr. 15 (1926) 129.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 518.

Distribution: Philippines. Indonesia: Bay of Batavia (I. of Leiden).—Atlantic: West Indies, Europe, incl. of Mediterranean; Indian Ocean; Red Sea; Pacific Ocean: Japan, Australia.

Use: The plants are commonly prepared so as to make a gelatine-like sweetmeat from them. Sometimes the species is eaten as a salad.

Chaetomorpha javanica Kuetzing

Vernacular name: lumut laut, sajur lompan, rumut kehur (Malay); Haair der Nymphen (old Dutch); Hauty, tsjen-thi (Chinese). (All names used in the Isle of Ambon.)

Literature: KUETZING Spec. Alg. (1849) 376.—RUMPHIUS Herb. Amb. 6 (1750) 90, 179—180 (sub nom. *Capillus nypharum, Sericum marinum, Muscus marinus* and *Muscus capillaris*) (not pl. 40, f. 3, this representing *Gelidium Amansii*).—VON MARTENS Die Tange (1866) 42.—HASSKARL Schlussel Herb. Amb. (1866) 323.—MERRILL Interpr. Herb. Amb. (1917) 53.

Distribution: Indonesia: Java, Ambon.—Atlantic: West Indies.

Use: According to RUMPHIUS the Chinese at Ambon collect these weeds in the months of August and September (dry monsoon). After being soaked a night in fresh water they are dried in the sun. The dried weeds are boiled and eaten with bacon.

Codium STACKHOUSE

(*Order*: Siphonales. *Fam.*: Codiaceae)

The thallus of the species of this widely distributed genus is spongy. The erect, richly dichotomously branched threads of the plants are anchored by a small cushionlike disk or by tufts of rhizoids on coral reefs or on exposed rocks in the surf (littoral region).

Note: In the Hawaiian Islands and in Japan, beside *Codium tomentosum* (see below), species of Codium other than are mentioned below are used. Miller (1946 [15], 47) stated that especially *Codium Mulleri* Kuetz. is eaten raw, usually with tomatoes, after being thoroughly washed in fresh water. It is never cooked or blanched, for it becomes soft and distintegrates quickly with heat.

Moreover, Miller states: "The ascorbic acid content of a specimen which had been kept in sea water in a refrigerator for 2 days after gathering was found to be low: only 5 mg of ascorbic acid per 100 grams".

The vernacular names of this species are: aalaula, limi wawaeiole, limu wawaimoa (Hawaii); popoklo (Philippines: Luzon (Ilocos Prov.)); silingsiling (Philippines: I. of Leyte, Cebu, Bokol (Visayan dialect)).

The method of preserving *Codium* species for food in Japan, is to put them in salt (OKAMURA (1933 [16])).

Codium tenue Kuetzing

Vernacular name: pupu-lo (Philippines: Luzon (Union and Ilocos Prov.)).

Literature: KUETZING Tab. Phyc. (1856) 33, t. 95.—SEALE *in* Philipp. J. Sci., D, 6 (1911) 309.—WESTER *in* Dep. Agr. Nat. Res., Philipp. Isl., Bull. 39 (1924) 21.—COLLADO *in* Philipp. Agr. 15 (1926) 129.—BURKILL. Ec. Prod. Mal. Pen. 1 (1935) 617.

Distribution: Phillippines. Indonesia: Sulu Archipelago.—Cape Good Hope; Indian Ocean, incl. Red Sea.

Use: Eaten raw as a salad in the Philippines.

Codium tomentosum (Hudson) Stackhouse

Vernacular name: susu lopek (E. Lombok); laur-laur (Celebes).

Literature: HUDSON Fl. Angl. (1723) 584 (sub nom. *Fucus tomentosus*).—STACKHOUSE Ner. Brit. (1797) 16.—VON MARTENS Die Tange (1866) 47.—BLANCO Fl. Philipp., Gr. ed. 3, 3 (1879) 260.—HOFSTEDE *in* Alg. Landb. Weekbl. Nederl. Indie 8 (1923) 319.—HEYNE Nutt. Pl. Nederl. Indie, 2nd ed., 1 (1927) 617.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 617.

Distribution: Widely distributed everywhere in Malaysia.—In all parts of the Oceans except the polar regions.

Use: The species is sold in the markets of Makassar and is used as food in several parts of Malaysia. It is eaten raw as a salad.

Okamura (1933 [17]) states that species of *Codium*, e.g. *C. tomentosum* are copied as designs in fine arts. One of the plants is neatly straightened out on paper in a flabellate form, then copied and used as a pattern on porcelain, fabric, wall paper, etc.

Enteromorpha LINK

(*Order*: Ulotrichales. *Fam.*: Ulvaceae)

Thallus of the plants tubular, simple or with more or less numerous branches. The species occur in the upper parts of the littoral zone near the shore in quiet waters, attached to small stones and rocks by means of rhizoids. Enteromorpha species are capable of enduring a wide range of salinity, therefore often occurring in brackish water of estuaries. The 3 species mentioned below are very closely allied; cf. Weber-van Bosse (1913 [18]).

Note: An extensive study of the food value of the Hawaiian *Enteromorpha* species was made by Miller (1927 [19]). The edible species are known as limu ele-ele or limu pipilani. A chemical analysis of an Enteromorpha species gave the following result (p. 19):

Water	90.34 %
Protein (N x 6.25)	2.82 %
Fat (ether extract)	0.0485%
Ash	1.59 %
Calcium	0.17 %
Phosphorus	0.0336%

As to the vitamin contents Miller stated (*p.* 24): "Limu ele-ele is a fairly good source of vitamin A and a less good source of vitamin B. The value of limu in diet is its flavor and its tendency to prevent constipation. Limu ele-ele has no antiscorbutic value".

Species of *Enteromorpha* are food for many fishes e.g. *Chanos chanos* (bandeng).

Enteromorpha compressa (Linnaeus) Greville

Literature: LINNAEUS Sp. Plant. 2 (1753) 1163 (sub nom. *Ulva compressa*).—GREVILLE Alg. Brit. (1830) 180, t. 18.—TRESSLER Mar. Prod. Comm. (1923) 112.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 928.

Distribution: Malay Peninsula. Indonesia: Sumatra (Bencoolen), Java (Bantam).—Cosmopolitan.

Use: Eaten in the Philippines and in the Malay Peninsula. From an analysis given by Tressler (*l. c.*) it seems that more than half of the weight of an air-dried plant is digestible food.

Enteromorpha intestinalis (LINNAEUS) LINK.

Vernacular name: lumot (Philippines: Luzon (Union and Ilocos Prov.)); ruprupu (Philippines: Luzon (Ilocos Prov.)).

Literature: LINNAEUS Fl. Suec., ed. 2 (1755) 432 (sub nom. *Ulva intestinalis*).—LINK *in* NEES Hor. Phys. Berol. (1820) 5.—SEALE *in* Philipp. J. Sci. D, 6 (1911) 309.—WESTER *in* Dep. Agr. Nat. Res. Philipp. Is., 39 (1924) 21.—COLLADO *in* Philipp. Agr. 15 (1926) 129, 130.—BURKILL Ec. prod. Mal. Pen. 1 (1935) 928.

Distribution: Malay Peninsula. Philippines. Indonesia: Java (Semarang).—Cosmopolitan, but as far I know not yet recorded i.a. for the Red Sea and the China Sea.

Use: In the Philippines the species is eaten raw as a salad. According to Hooper (1926 [20]) the Chinese import it dried into the Malay Peninsula. It is eaten by the Japanese as a supplementary article of diet with boiled rice only after being sun-dried (1933 [21]).

Enteromorpha prolifera J. G. Agardh

var. *tubulosa* (Kuetzing) Reinbold

Vernacular name: unknown.

Literature: J. G. AGARDH Till Alg. Syst. 3 (1882) 129, t. 4, f. 103-104.—KUETZING Tab. Phyc. 6 (1856) 11, pl. 32.—REINBOLD *in* Schrift. Nat. Ver. Schleswig- Holst. 8 (1890) 117.—BURKILL Ec. Prod. Mal. Pen. 1 (1935) 928.

Distribution: Malay Peninsula. Indonesia: Java (Batavia) Leti I.—Atlantic: European coast; Indian Ocean; Pacific Ocean: American coast.

Use: Only mentioned as eaten on the shores of the Malay Peninsula.

Ulva LINNAEUS

(*Order*: Ulotrichales. *Fam.*: Ulvaceae)

The flat, broad and membranaceous thallus consists of two layers. It is attached by a small disk to rocks, stones, valves, etc. in the upper part of the littoral zone (ultra-and supra-littoral belt). These seaweeds prefer spots where the water is polluted by organic matter and where supplies of fresh water mingle with seawater.

Ulva lactuca Linnaeus

Vernacular name: unknown.

Literature: LINNAEUS Spec. Plant. 2 (1753) 1163.—BURKILL Ec. Prod. Mal. Pen. 2 (1935) 1196.

Distribution: Malay Peninsula. Philippines. Indonesia: Sulu Is., Kei Is., Celebes, Lombok, Sumba, Banda, Solor I., Salebabu Is.—Cosmopolitan.

Use: Though *Ulva lactuca* is a common plant in the whole of Malaysia it is mentioned only by Burkill. However, this author states that the sea lettuce is eaten widely in the East, in soup, as a salad and that it is employed for garnishing. On account of this it is somewhat surprising that no vernacular names are reported from these regions. In Hawaii (Reed, 1907 [22]) it is called by the natives limu lipalahalaha and in Japan (OKAMURA, 1933 [23]) awosa-awosa.

In Singapore the plant is used only for feeding pigs. It may be that it is neglected there as human food because "the sea water is not a little polluted".

Tressler (1923 [24], 112) gave an analysis showing that 50% of carbohydrates are present and 15% of proteins if water be reduced to 19%.

(FOOTNOTES)

(1) A dictionary of the economic products of the Malay Peninsula.—London (1935) 1—2402.

(2) Blumea, Suppl. 1, J. J. SMITH Jub. Vol. (1913) 176—182.

(3) Garden's Bull. S.S. 9, 2 (1937) 187—189.

(4) Blumea 4, 1 (1940) 3.

(5) The structure and reproduction of the Algae, I.—Cambridge (1935) 1—791.

(6) Proc. Fifth Pacific Sc. Congr. 4 (1933) 3153—3161.

(7) This was kindly communicated by Miss Dr. Josephine Th. Koster, Rijksherbarium, Leiden, Holland.

(8) Cf. Footnote 6).

(9) The J. of Ecology 25 (1937) 431—468.

(10) Cf. footnote 6).

(11) Though the exact species is not mentioned in this paper, it is cited here, as *C. racemosa* and is the most widespread species in the Malay Archipelago.

(12) Contrib. U.S. Nat. Herb. 9 (1905) 177.

(13) Cf. footnote 5).

(14) Ann. Rep. Hawaii Agr. Exp. Sta. f. 1906 (1907) 61—88.

(15) Foods used by Filipinos in Hawaii (1946).

(16) Cf. footnote 6).

(17) Cf. footnote 6).

(18) Liste des algues du Siboga, I (1913) 1—186.

(19) BERNICE P. BISHOP Mus., Bull. 37 (1927) 1—25.

(20) Gard. Bull. S. S. 6 (1929) 57.

(21) Cf. footnote 6).

(22) Cf. footnote 14).

(23) Cf. footnote 6).

(24) Marine products of commerce.—New York (1923).

Section 4

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SYMPOSIUM PAPERS

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IPFC/C49/SYM1A	A Survey of the Pelagic Fisheries of the World, by H. Srinivasa Rao and N. K. Panikkar.	IPFC/C49/SYM3	Development of Pelagic Fisheries by J. D. F. Hardenberg.

* Not included here since the full paper is published.

A SURVEY OF THE PELAGIC FISHERIES OF THE WORLD

Part I: GENERAL CONSIDERATIONS

By

H. Srinivasa Rao

INTRODUCTION

It has been a great privilege to be asked to open the discussion on the World Pelagic Fisheries in the symposium arranged by Dr. G. L. Kesteven as part of the proceedings of the Singapore Inaugural Meeting of the Indo-Pacific Fisheries Council. The literature on the subject is very extensive, and scattered in many books, journals and periodicals published in the five continents. Owing to the shortness of notice for the preparation of the paper, it has not been possible to review any but a fraction of the literature on the subject, and no one is more conscious than myself of the incompleteness and inadequacy of the paper presented. I hope, however, that the more salient features of the subject have been touched upon in this brief review, and that these will lead to a fruitful discussion. I should like to take this opportunity to offer my sincerest thanks to Dr. G. L. Kesteven, F.A.O. Regional Representative (Fisheries) for every encouragement and for readily placing at my disposal a list of bibliography on the subject which he had prepared, and to my colleague, Dr. N. K. Panikkar who, at very short notice, was able to get together a considerable part of the locally available literature at Madras and to prepare a general connected account of the biology of pelagic fishes from his own and my notes on the subject.

The paper is presented in two parts: (1) General considerations of the pelagic environment as influenced by latitude, climate, currents, tides, and the biological and physico-chemical contents of the sea and their influence on fish and fisheries; (2) Biology of pelagic fishes, chiefly of the shoaling forms such as herring, mackerel, horse-mackerel, flying fish, so far as is known and has been possible to gather in the short time at our disposal.

Geographical divisions of the oceans. The pelagic region of the oceans is a part of the marine biocycle of the world which may be divided geographically into two main divisions, viz (1) the Atlantic with its connections in the North and the South with the Arctic and Antarctic waters respectively, and the associated partially land-girt seas—the North Sea, the Baltic Sea, the Mediterranean Sea, the Gulf of Mexico and the Carribbean Sea, and (2) the Pacific and Indian Oceans with their connections in the South with the Antarctic, and with a northern connection for the former Ocean with the Arctic by the Behring Sea. The Red Sea, the Arabian Sea, the Bay of Bengal and the Andaman Sea, the China Sea, the Sulu Sea, and the Java, Sunda, Arafura, Banda and Celebes Seas of the East Indies and the Japan and Yellow Seas are more or less land-bounded.

Oceans of the world as a continuous domain for marine organisms. The oceanic mass of water thus constitutes for marine organisms a single continuous domain whose populations are, as a rule, of greater density in the upper strata of water than the lower, and exhibit in the former a greater diversity of form and organisation. With the exception of a few of the higher forms of life such as the seals, whales, dolphins, turtles, snakes, which have secondarily adapted themselves to life in the sea, the majority of sea organisms have the ocean as their original home. This marine domain or bio-cycle has been estimated to have about 300 times the habitable space provided by the terrestrial and fresh water biocycles together. It may be broadly divided into the primary and secondary biotic divisions based upon the physical nature of the sea or upon the nature of the biota.

Physical and biological divisions of the oceans. The two primary divisions of the oceans are (1) the benthic including all the ocean floor and (2) the pelagic including the whole mass of water. Although this article deals specifically with the latter division, the physical and biological continuity of the marine domain or bio-cycle makes it necessary that the characteristic features of both the divisions be taken into account if the significance of factors affecting pelagic fisheries is to be fully understood. The pelagic division is further sub-divided into the Neritic and the Oceanic regions corresponding to the littoral and the abyssal sub-divisions of the benthic, in reference to the depths to which light penetrates the neritic and oceanic regions and to the extent and depth of the continental shelf. These are not, how-

ever, absolute divisions as depth of penetration of light in the neritic region may be affected by the turbidity conditions of the sea and the extent of the continental shelf may be correlated with the geological formation of land masses and the extent of terrigenous deposits brought in by rivers.

Physical and biological characteristics of the benthic divisions of the sea.

Fishes of both the benthic and the pelagic divisions of the ocean have to depend for their sustenance on the organisms and organic substances produced in it either in the form of plants or animals or in the form of organic detritus. The benthic division from the shore to the abyss is usually covered by sedimentary terrigenous deposits, organic or pelagic oozes, and red clay. Except for the fact that the deep sea deposits, consisting of nutrient organic and inorganic matter, may be brought within the range of the neritic region by upwelling and currents in the ocean, the terrigenous deposits restricted to the configuration of the continental shelf seem to influence the greater productive capacity of the coastal region in reference to fisheries. Plants are the real sustainers of animal life in the sea in general, and the production and distribution of plants in the sea depend upon a great variety of factors chief among which are light and available nutriment in the biotic division in which they occur. The eulittoral zone of the benthic division which can support large attached plants constitutes only about two per cent of the sea floor, and even here unfavourable substratal conditions restrict the production of such plants.

The function of primary food production in the sea therefore devolves on the unattached floating plants, e.g. phyto-plankton—such as, algae, diatoms, flagellates, coccolithophores, etc. which occur in enormous numbers. The phytoplankton may be divided broadly into neritic and oceanic populations. As the conditions of salinity, temperature, turbidity and other environmental factors vary considerably in the neritic region as contrasted with the more stable conditions in the oceanic region, it may be supposed that phytoplankton production in the coastal belt may be adversely affected, but in actual fact the waters of the neritic region are believed to be fifty times more productive than the open oceanic waters (Lohmann, 1908) as substantiated by the abundant benthic and pelagic fauna in the former. The production of phyto-plankton is in general conditioned by light and latitude, and by available nutrients in solution. The source of these nutrients in solution in neritic or oceanic waters is the decomposing plants and animals brought down from land or present in the sea. It has been shown that the periphytic bacterial population of pelagic waters has a tendency to follow closely the distribution of plankton ensuring thereby the thorough decomposition of dead planktonic organisms even before they have had time to sink to great depths and the regeneration of mineralized plant nutrients in the upper layers of water both in and below the euphotic zone. The upper layers of water have however a relatively poor concentration of nutrients as compared to the bottom layers, more particularly in the interface between mud and water, unless augmented with nutrients from the bottom by processes of vertical diffusion, convection overturn and upwelling.

Biological characteristics of the oceanic regions of the pelagic division.

The oceanic pelagic life is made up of animals independent of the bottom throughout their development (Radiolarians, Foraminifera, Hydromedusae, Siphonophores, Ctenophores, Chaetognaths, copepods and hyperines among crustacea, heteropods, pteropods, appendicularians, salps, pyrosomas, some sharks, a great number of bony fishes with air-bladder and some without, and the whales). The neritic pelagic includes, in addition to the above, animals which are dependent on the bottom during part of their existence (medusae with alternating generations, larvae of benthic animals, floating eggs of many fishes, water fleas, *Podon* & *Evadne* whose eggs sink to the bottom, and the ostracod *Philomedes* and numerous other free-living crustacea). Many cephalopods, most sharks and rays, many bony fishes of the neritic pelagic are included which rest at the bottom at night. The sea turtles, seals and walruses which belong to the pelagic region feed on benthic forms. The time and season of dependence on the bottom vary with different animals so that periodic changes in the composition of the neritic pelagic are much more pronounced than in the oceanic. The outer seaward boundary of the neritic pelagic is generally the 200 metre contour of the benthic region, and includes the banks as well as coastal waters. This boundary is the obvious result of dependence on the bottom. Inhabitants of the neritic and oceanic pelagic are usually mixed at the boundary, and currents carry neritic forms out and oceanic ones in, generally to their destruction, although the eels are a notable exception.

As the maximum production of phytoplankton is restricted to the lighted zone, animals of the pelagic region, whether adult or larvae, which permanently or temporarily live in it to feed on phyto- and zoo-plankton, will be restricted to the lighted zone. All true pelagic animals are independent of the bottom in that they have the ability to main-

tain themselves in open water without sinking. Some animals like the ctenophores never sink to the bottom, while many elements in the pelagic fauna are larvae of animals which spend their adult life in the benthic region. Where the pelagic or benthic period is very short the animals must be reckoned as benthic or pelagic respectively as the case may be. Mackerel which unquestionably belong to the pelagic region are known to spend part of the year resting on the bottom.

Economy in the use of hard skeletal matter such as lime, and silica, the absorption of large amounts of water in the jelly-like tissues, storage of lighter materials such as water of less salinity, fat, or even air in the tissues, the accumulation of fat, oil or air in the bodies or eggs are devices to help obviate the natural tendency of pelagic animals to sink. The bony fishes and the air-breathing sea vertebrates such as turtles, snakes, whales, sirenians, and seals of the pelagic region have solved their respective buoyancy problems in the pelagic region by the development of an air-bladder and by retention of their lungs. The retardation of sinking by changes in form is a widespread phenomenon among pelagic invertebrates. Flattened leaf-like form, suspensory bristles, long tentacles and appendages are among the means of suspension. Resistance to water produced by active muscular swimming is, however, the most widespread means of preventing sinking. In the fastest swimmers such as the blue shark and the mackerel every device calculated to reduce the resistance of the moving body to water is employed. The viscosity factor in water, which depends chiefly on temperature but less markedly on salinity is also of importance in reducing the rate of sinking. The pelagic animals of the Polar regions and of the oceanic depths with more or less identical viscosity conditions are, therefore, better able to suspend themselves in water than those of the tropical regions. The variation of viscosity with temperature may bear upon the fact that many pelagic organisms are smaller in warm seas than in cold, but notable exceptions to this have been recorded amongst diatoms (Wimpenny, 1936-37).

Characteristics of plankton and nekton. Free swimming forms of the pelagic which are independent of oceanic currents are grouped as nekton to distinguish them from the passively floating or suspended plankton, but no sharp distinction can be maintained between these two groups of animals. Such independence is reached only by certain fishes (tunny, bonito, etc.), cephalopods, reptiles and the homoiothermal marine mammals. Both plankton and nekton include predaceous and herbivorous forms and cannot be distinguished on the criterion provided by food habits.

Methods of procurement of food by pelagic animals. Special means of securing food are required by pelagic animals since their food differs from that of benthic animals. The predatory pelagic animals of this region, however, employ the usual methods of chase and capture. The basic food supply is provided by the phyto-plankton for a variety of organisms such as the pelagic protozoa, copepods and even larger animals like whales etc. The large plankton animals, from small metazoa to the size of pteropods, form the food of larger pelagic animals. A special apparatus for plankton collection has been developed convergently in the plankton feeders—which are divided into (1) those which feed by sticky tentacles, (2) those which produce a current of water which carries food, and (3) those which hunt actively. A divergent group of animals strains out living animals from a stream of water produced by themselves (Cladocera and copepods, salps and pyrosomas, the remarkable apparatus of appendicularians, the sieve-like strainers of the plankton-eating fishes such as herring or the giant sharks, and the baleen of the toothless whales).

The permanent pelagic biota. Exclusively pelagic animals are the radiolarians, medusae, siphonophores, ctenophores, Chaetognatha, pelagic crustacea and Mollusca (Heteropoda and Pteropoda, *Ianthina* and *Phylliroe*), salps and appendicularians. Amongst these the pelagic copepod crustaceans predominate, comprising 90% of the whole fauna with schizopod, decapod and other forms in addition. Next come the pteropods, siphonophores and Chaetognatha while cephalopods and fishes are an important element. The microplankton (constituting what is known as nannoplankton) and macroplankton also form part of this biota.

Wind and currents play a large part in the wide distribution of pelagic animals which remain in free suspension in water. Those endowed with feeble powers of swimming are no exception to this mode of distribution.

Among longer-lived animals aggregations appear which may be due to instinctive gregariousness as in schools of herring, mackerel, cod, etc. wandering to feeding or spawning grounds.

Composition of plankton varies with time as well as locality. It is usually composed of a great number of different animals but at a given place and

special time a single species may flourish to such an degree that it predominates to the extent of being termed a monotonous plankton. This is especially a phenomenon of the shallow seas more particularly of the colder waters lying over them.

There is difference in the composition of the surface plankton between day and night. At night numerous deep sea forms come to the surface even from great depths to return before day break. These are followed by predatory forms which live on them. The schools of herring come to the surface at night, remaining at considerable depths during the day. This suggests possible success in tropical latitudes of surface fishing by night and or of deep-sea seining by day.

Deep bays, fiords, lagoons of coral reefs operate like traps for plankton and destroy them. Oceanic and neritic plankton suffer in storms and are driven ashore in great masses.

The difference in density of marine populations in the oceanic and neritic regions is much greater than between those of the polar and tropical regions. This may be due to the greater food supply in shallow water brought about by the greater development of phytoplankton as a result of the accumulation of organic and inorganic deposits from land. The pelagic population is more or less self-sustaining, the food chain of which, from the smallest single-celled alga to the largest fish and toothed whales, is extensive and conditions the distribution of the larger forms of animal life. The mackerel fishery at the mouth of the English Channel depends on the amount of animal plankton, especially copepods; the appearance of the herring on the north coast of Iceland depends on the summer development of the copepod *Calanus*, and the complicated migration of the herring (except spawning migrations) and the movement of schools of whales seem to be dominated by their food supply. In open and warm seas the zooplankton lies at a deeper level on which large crustaceans and cephalopods feed which in turn form the food of the larger pelagic animals such as sperm whales.

Effect of currents on the distribution of pelagic animals. The pelagic habitat or biotope is influenced considerably by oceanic currents and eddies more particularly in the distribution of its inhabitants. Both passive and free swimming forms are affected by them. The study of surface currents has shown that they may form an open or closed circuit. A closed current returns its animals through a wide range of temperature and environment as in the case of *Calanus finmarchicus* of the Norwegian Sea affected by the Gulf Stream. The closed circuits of the North and South Atlantic take about one to two years to return the plankton to its place of origin. The period is long enough to include several generations of short-lived plankton in addition to those larger animals with longer periods of development.

The non-circulating warm currents like the gulf stream or the Japan current and the cold currents like the Labrador current or Humboldt current or the Ojashie current provide different conditions of life for the pelagic animals which come within their range and, where warm and cold currents meet, the contrast in temperature and volumes of water which oppose may cause great mortality among plankton as it happens on many banks (New England, Agulhas, Spitzbergen and East Coast of Japan). This massive and extensive destruction of pelagic life may cause a temporary scarcity of life in that region but this provides an opportunity for the bottom fauna to thrive on the remains of the pelagic fauna, and for the phytoplankton to derive its nourishment from nutrients liberated by the disintegrating plankton which sink to the bottom. The plankton carried along by currents changes its composition as it goes along as a result of admixture from adjoining sources, but some of these have their characteristic plankton (index forms) by which the currents could be demarcated in the open ocean (*cf. Calanus hyperboreus* of the polar current north of Iceland and *C. finmarchicus* of the Norwegian Sea). Large numbers of animals are often found to accumulate at the borders of currents (*Salpa flagellifera* on the border of Benguela current and pteropods on the borders of great currents).

Macroscopic floating algae constitute a pelagic benthos or pseudobenthos in surface waters. Algae provided with floating bladders (*Sargassum* of the North Atlantic and the Indo-Pacific, *Macrocystis* of the South Pacific) may be carried into a quiet whirl pool forming a special biotope of the pelagic (eddy of the Atlantic Sargasso Sea). The algae constitute the home of a number of littoral animals from the Caribbean Sea even when they reach the eddy area on the high seas. The changes from the littoral to the half pelagic life in the Sargasso eddy being so radical for many of the animals originally attached to the weeds, the fauna in the Sargasso Sea is poor in species but rich in individuals. The animals living on the weeds constitute a pseudobenthos. A number of unexplained faunal parallels exists between the fauna of the Sar-

gasso Sea and that of the Mediterranean Sea in the composition of the nannoplankton, in the forms of certain Radiolarians, Annelids, and Copepods. The Sargasso Sea is characterised by poverty of plankton, transparency of water, high temperature of water at depths between 200 to 400 meters in comparison to temperatures at corresponding depths in adjacent waters due probably to the greater density of surface water which is carried down to oceanic depths compensating in parts for the upwelling currents on leeward coasts.

The euphotic and dysphotic strata of the pelagic region. The pelagic environment may also be considered in two different major strata:— (1) The richly lighted euphotic stratum varying in depth, according to different authorities, from 0 to 100 metres, and (2) the weakly lighted dysphotic stratum varying in depth from 30 to 500 metres. The majority of shoaling pelagic fish belongs to the euphotic stratum while some species wander from the one to the other keeping track of the vertically moving plankton. The animal communities of the sea are extensive life zones comparable to the climatic zones of the continents, but in area, homogeneity of environmental factors, and the associated biota they surpass the latter. These communities may be subdivided into two main groups—of warm and cold waters corresponding roughly to the tropical and sub-tropical areas and the cold polar and temperate areas. The indistinct and ill-marked boundaries between these are determined by isotherms of surface water rather than by latitudes. But there has been some difference of opinion between authorities (Ortmann & Meisenheimer) as to the limits of these boundaries. According to the latter the tropical animal communities of the Atlantic and Indian Oceans are united around S. Africa but according to the former entirely separated by the South African continent.

Division of the oceans into temperature belts. The warm and cold regions of the sea can be sub-divided based upon the reactions of marine animals which seem to recognise an equatorial belt of water with a temperature above 25° C. as distinct from the relatively cooler waters lying on either side of this belt with a temperature range of 20° to 25° C. The colder waters around the poles with temperatures below 10° C. form a distinct belt from the less cold waters with a temperature range of 10° to 15° C. The North Atlantic region which has been better studied than others can be divided still further based on the distinctive animal communities designated as Arctic and Boreal. In the open ocean itself temperature barriers with indistinct and varying seasonal boundaries exist in the regions affected by circulating or terminating streams of cold or warm water, and the pelagic animal communities associated with these seem to keep pace with these changes in boundaries.

Seasonal periodicity in the pelagic biota and their composition in tropical & cold waters. Seasonal periodicity which is so characteristic of the circumpolar waters seems to be lacking in the warm waters of the equatorial belt, but this has its advantages as well as disadvantages. The more constant warmth seems to keep the extensive propagation of a stenothermal animal community whose metabolism and growth are so accelerated as to quicken the process of succession in animal generations favouring mutations which give rise to a large number of genera and species. In colder waters, this variety which adds to the numbers of a generation is compensated for by a larger number of individuals of the few species that occur. Pelagic fisheries in the warmer waters therefore provide a larger variety of fishes which is no disadvantage from the commercial point of view, but present difficulties in the scientific interpretation of fisheries. The depth to which light penetrates in the tropics would presumably extend the vertical range of pelagic fisheries, suggesting the adoption of methods of catching fish different from those in vogue in colder waters, where the concentration of pelagic fish in surface waters is understandable. The following members of the pelagic communities in tropical seas indicate the great variety of forms which provide food for pelagic fish: Foraminifera (20 species as against 1 or 2 in colder seas), Siphonophora, geryonid Hydromedusae, charybdacid Scyphomedusae, alcyopid Polychaeta, Copepoda (*Copilia*) *Euphausia, Sergestes* and *Lucifer* among Crustacea, the Heteropoda, Pteropoda and the pelagic *Ianthina and Phylliroe* among the molluscs, *Pyrosoma Salpa,* and *Appendicularia* among tunicates, the Exocoetidae among fish, besides a whole host of free swimming larvae of corals, echinoderms, molluscs, worms, crustaceans and fish.

The low temperatures of the colder waters seem to result in the reduction of fertility of animals although compensated for by the size of the eggs and in the suppression of the free-swimming larval forms which while retarding wider dispersal result in enormous over-crowding by the more successful members of the benthic communities. The Hydrozoa among Coelenterata, the Holothuroidea among Echinodermata and siliceous sponges among Porifera are among the groups of animals which seem to find favourable conditions of existence in the colder waters. The

higher crustacea apart from genera like *Acanthephyra* are usually absent, while copepods—many of them distinct from those in tropical waters—occur in enormous numbers of individuals favouring the growth of fish which mainly feed on them. The schizopods, hyperiids and pteropods are also characteristic of colder waters. The richness of diatoms in these waters explains the abundance of organisms like Radiolaria and Ciliata which use lots of siliceous skeletal material. A definite periodicity exists in the plankton of colder waters which are richer in plankton in the summer. Whether this production of plankton in colder waters over an entire year is greater than that of the tropical waters over a similar period is still unascertained, and the prevailing view, that the tropical seas are quantitatively poorer in plankton than the colder, based on somewhat meagre observations and vague generalisations, which holds the field, merits re-examination. In any case comparisons of the populations of pelagic regions of the tropical and colder seas appear to have been made on the basis of information obtained for the Atlantic Ocean only where difference in density of population may not be due to temperature alone. Moreover, the Indo-Pacific Seas, which are in more open communication with the Antarctic and Arctic Oceans and have a much longer coastline skirting them, broken by numerous bays, gulfs, rivers and estuaries, may possibly have as rich a pelagic fauna as that of the equatorial Atlantic.

The richness of life in the pelagic region of the colder seas attracts a large number of birds, mammal predators such as penguins, whales, seals, etc.—a phenomenon little in evidence in the open warmer seas where abundant plankton such as is known in the Indian Ocean occurs, but here the corresponding surface feeders are the shark, the porpoises, etc.

Bipolarity or the similarity of the pelagic organisms of the Arctic and Antarctic waters has been observed in many groups of organisms but none of the explanations offered for this phenomenon can be said to have received universal approval. A compromise between the opposing views suggested is to treat the similarity between the polar faunas as primary and the differences as secondary.

Conditions of pelagic life in virtually enclosed seas. The smaller areas of the ocean such as seas, bays and gulfs appear for all practical purposes as separate areas with their distinctive temperature, salinity and biological conditions. The discharge of large rivers which controls salinity, latitude which determines the evaporation, and topography which may determine the extent of exchange of waters between such isolated parts and the ocean are factors influencing the fauna. While in the polar sea salinity is decreased in summer by the melting of ice, in the tropical seas the increase in salinity in summer is due to increased evaporation. In the deep basins like those of the Baltic, the Mediterranean (Levantine and Ionian Seas), and the Red Sea, animal life becomes sparse owing to poverty of dissolved oxygen and richness of carbon dioxide. In certain seas like the Black Sea the fauna is affected still further by large amounts of hydrogen sulphide in solution as a result of inadequate circulation of water.

Chemistry of sea-water in relation to plankton. Considerable advances have been made in recent years in our knowledge of the chemistry of sea-water in relation to the plankton and especially the factors which determine the productivity of the sea. In the earlier section reference was made to the effect of light, temperature and turbulence on the growth of phytoplankton. The second aspect which requires examination is the influence which the concentrations of nutrient salts in seawater have on the rate of growth and multiplication of the plant life that constitutes the phyto-plankton. When diatoms grow they utilize phosphates and the available nitrogen compounds—nitrates, nitrite, ammonium, uric acid, urea and probably amino acids—until these substances reach a concentration so low that plant life cannot grow and multiply in the normal manner. When only low concentrations of these nutrient salts are available the plankton production would be low. In the colder seas the burst of diatom activity in spring followed by the zoo-plankton peak results in the depletion of nutrients from seawater, but the inactivity during winter months results in accumulation and regeneration of nutrients which in their turn are used up during the succeeding spring. A cycle of this type does not exist in tropical waters owing to the absence of winter; consequently, the large annual variations in phosphates and nitrates observed in the colder seas are not encountered in the tropics. This does not mean that seasonal variations are totally absent. Changes in the direction of currents, winds and the upwelling of waters which they produce often result in seasonal variations which in their turn affect the plankton and fisheries.

In addition to nutrient salts small amounts of iron for plant pigments, silicates for the shells of diatoms, carbon dioxide for photosynthetic activity and probably other trace elements are essential for the growth of phyto-plankton.

The foregoing general considerations based on available data would seem to explain partly the pre-

sent distribution of pelagic fisheries of the world. The severity of northern climates, which does not help production of adequate agricultural crops, must have also contributed to the greater concentration on the part of the peoples of these climates on fisheries as an industry, and traditions of feeding and clothing changed only very slowly under compelling circumstances. The abundance of food in regions with highly developed agricultural, horticultural and livestock industries in certain tropical and sub-tropical regions seems to have led to the relative neglect of coastal waters as sources of food. Almost the entire east coast of S. America (Brazil, Argentina, etc.), many parts of Africa, Asia and Australia provide examples of unexploited or inadequately exploited waters for fisheries where food from agricultural and other sources has been available for a great majority of the populations. In these areas fisheries provide accessory food, not an important item of food as in the countries of the temperate and boreal regions.

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Part II: THE BIOLOGY OF PELAGIC FISHES

by

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THE HERRINGS AND ANCHOVIES.

Both in numbers and in economic value the fishes belonging to the family Clupeidae rank first among the food fishes of the world. They are represented in all temperate and tropical seas and often form large shoals swimming on the surface and performing long migratory journeys. Although most of them are marine, there are a few species which occur in freshwater and, a still larger number that ascend rivers at some phase of their life history. The pelagic species, which are more in the habit of forming shoals than the coastal and estuarine species, are mostly of a small size and, at any rate, never exceed a foot in length. In fact, most species are much smaller and, especially so are the tropical forms averaging from 4 to 8 inches; their economic value would have been negligible but for the enormous numbers in which they appear, providing a source not only of edible fish, but also of fish oil, fish meal and fish manure. This group comprising about sixty species includes the herrings of the North Atlantic, the true sardines of S. Europe, S. America, the Pacific and S. Africa, the menhaden of Atlantic coasts of America, the sprat, the pilchard and the closely related forms shoaling along the coasts of S. Europe, West Africa, India, the Far East, Australia and New Zealand.

Taxonomic Difficulties. The taxonomy of clupeids presents considerable divergence of views. The earlier workers distinguished only one genus *Clupea* for the herring, the sprat, the pilchard, the shad and the many other sardines but in recent years this

has been subdivided into numerous genera. The herring of the Atlantic, *Clupea harengus*, is the best known of all clupeids; in fact, many of the recent ideas relating to fishery science has grown around this species. It is common to both sides of the North Atlantic in the cooler latitudes and extends even to the seas north of Asia. In the North Atlantic, the species has given rise to many types of fisheries in different parts of the year. Thanks to the studies of Hjort, Heincke, Lea, Schnakenbeck, Fulton, Ford and many other fishery naturalists, we have a fair amount of all round information on its habits and movements. Herring is the only known instance of a clupeid whose eggs are demersal and not pelagic; the spawning grounds in the North Atlantic are now well known. The fish spawns both in spring and the autumn.

The growth is slow; the spring herring at the end of the year is hardly 2 inches long while the autumn herring for the same period would show only a much less growth and is rarely over 1½". These differences in growth and the habits attendant have given rise to herrings being recognised broadly as spring spawners and autumn spawners; some authors consider that these are different races. Both males and females attain sexual maturity in about 4-5 years. It is in connection with the herring that the question of races in commercial fishes assumed importance. The pioneer work of Heincke on different samples of herring distributed all over the Atlantic led him to state that he was able to distinguish two main groups of herring, viz., Spring or coastal herring and Autumn or sea herring. He was further able to distinguish many local groups and varieties, whose validity, however, is disputed by other workers, but each particular fishery is often associated with a definite "race" of herring. The great Scottish Fishery is concerned with the sea or Autumn herring as also the great English drift net fishery on the East coast. The Norwegian and Baltic herrings which contribute to great fisheries in Scandinavian countries comprise Spring or coastal herrings. Both drift net and trawl fisheries in a particular area may be based on the same race and stock. According to Ford (1933) the Plymouth winter drift net fishery for herring is subject to seasonal as well as daily fluctuation; this has been indicated as being caused by the variations in the number and character of the boats engaged in the fishery and to the intensity of fishing. These, however, do not fully account for the fluctuations in catches which probably depend upon the behaviour of the fish in the fishing ground itself as they seem to move out off shore during stormy weather. Graham (1931) has described the phenomenon of "swim" in herrings—his explanation being that "herring in a normal state can see the nets and avoid them, so that the sea may be full of herring, yet none caught. When however, they are under the influence of crowd excitement (due to panic, sexual excitement or migratory impulse) herrings are more or less unable to see the net, and are caught".

Race Studies.

Herrings that are landed can usually be classified into three categories:—(1) Full fish in which the roes and milt are fully developed, (2) spawners in which the gonads are actually in the running condition and (3) spent fish.

C. harengus extends to Arctic waters both on the Atlantic and Pacific sides, but the main species of Pacific herring is *C. pallasii* which is also interesting in the fact that it is discontinuously distributed, being found in the White Sea north of Europe and in the sea east of Kamchatka.

The Sprat.

Closely related to the herring is the sprat (*Clupea sprattus*) found all round the British Isles, extending in the North Sea as far north as Norway where the fish are extensively canned as "sardine". It is much smaller than the herring and were formerly considered as their young ones. The spawning begins in January and lasts till June or July. The egg is pelagic.

The Pilchard.

The South European Pilchard (*Sardina pilchardus*) on the other hand is a warm water species and is rarely found in Northern waters. It is also a small species, occurring in large numbers along the coasts of Southern parts of Ireland and England, France, Spain and Italy, and the coasts of North West Africa. This is the well known European sardine which has been highly developed as an industry in the countries of S. West Europe. The spawning ground is 20-40 miles out at sea but the fishery is concerned not with mature spawning individuals but with juvenile stages. The species is found in the warmer Southern waters of Europe during winter.

The Menhaden & Shad.

On the American side of the Atlantic to the south of Cape Hatteras, the clupeids are represented by the Menhaden (*Brevoortia tyrannus*) and the American shad (*Alosa sapidissima*) both of which contribute fisheries of great magnitude. The shad is one of the most important of American food fishes. Originally confined to the Atlantic Coast and the rivers entering the ocean, the shad has

been successfully introduced into the Pacific waters; but this is not a shoaling fish.

Although the American Menhadens include several species, *Brevoortia tyrannus* is the most important one which is found on the Atlantic coast extending from Nova Scotia to Florida and southward up to Brazil. In the South Atlantic regions extensive menhaden fisheries are located in North Carolina and Florida. In volume of production it ranks second among all United State fisheries and is caught in the South Atlantic and Gulf Coasts in greater quantities than all other fishes.

On the Pacific coast of American *Sardina caerulea* or the Pacific sardine ranks first in importance and is the mainstay of the California fisheries. Much work has been done on this species—especially statistical study of the catches and catch per unit effort. There is both an autumn and a winter fishery.

Other Sardines. The true sardines belonging to the genus *Sardina* are confined to the cooler waters of the Northern or Southern hemispheres. To the west of South America in waters washed by the cold Humboldt Current, and in the South African coast washed by the Benguela Current, we come across large shoals of *Sardina sagax,* which is considered by certain authors to extend its range to the Japanese coasts. On the Australian and New Zealand coasts, on the Antarctic side, there are extensive fisheries for *Sardinops (Sardina) neopilchardus, Clupea bassensis* and *Harengula castelnaui.*

In the tropical belt the Clupeids are represented by a large number of species and genera but true sardines of the genus *Sardina* and herrings of the genus *Clupea (sensu stricto)* are conspicuous by their absence. Their place is taken up by species of *Dussumieria* (Rainbow sardine), *Dorosoma, Spratelloides, Amblygaster, Alosa, Sardinella, Harengula, Pellona* and *Ophisthopterus* and a large number of species of Anchovies of the genera *Engraulis* & *Stolephorus.* We shall refer to these subsequently. Among the former category of Clupeid species, the relative importance of the species or groups of species in different areas yet remain to be worked out. From the information we have at our disposal species of *Sardinella* appear to be the most important as shoaling fishes. S. *cameronensis* and S. *aurita* are caught in large numbers on the Gold Coast in July to September, a fishery which according to Howat (1945) seems to coincide with the influx of cold waters from the south, more saline in character and with a higher phosphate content. On the Indian coast, the Oil Sardine, *Sardinella longiceps,* used to appear in enormous shoals on the Malabar coast and gave rise to a most flourishing industry, but these shoals have not been encountered during the past twenty-five years with the exception of small shoals which have appeared within certain years but which were in no way comparable with the shoals which appeared at the time of the old fisheries. Judged from this and the fact that rare instances of shoals of this species have been known to visit the Bay of Bengal, its movements seem to be most uncertain and the solution of this problem is one of considerable value to the Indian fishing industry.

Oil Sardine of Malabar. Investigations on the Oil Sardine have been carried out in India since 1908 when Hornell made his preliminary survey, and a summary of the more important results obtained by Hornell and Nayudu was published in 1924. These studies were made at a time when much of our modern methods in fishery research had not taken definite shape. Nevertheless, their conclusions may be briefly reviewed. They were not able to establish local races among the Oil Sardines of the Malabar and Kanara Coasts. On the other hand they contend that this is a species which is not liable to great variation in its characters.

The species attains sexual maturity and almost full adult size at the age of one year, when individuals are about 15 cms. long, and leave the inshore waters prior to spawning which takes place from June to August. The young again migrate into shallow waters. Their season of abundance as a fishery is from September to December. Growth during the second year is extremely slow, and it is reckoned that the oldest sardines examined were about 2½ years old which probably represent the maximum length of life of the species. Like all pelagic clupeids they are exclusively plankton feeders. Based on examination of scales, Hornell and Nayudu were able to establish a period of arrested growth from December to April coinciding with a season of poor plankton. Devanesan (1943) made further studies on the growth rings in scales but a careful distinction between the annual and so-called false rings does not appear to have been made by this author in his counting of the rings. These distinctions have been clearly set forth by Walford & Mosher (1943) from their study of the Californian Sardine (*S. caerulea*). The use of otoliths in determining the age of the oil sardine has been recently suggested by Nair (1949) who is of the view that the oil sardine attains maturity at about the end of two years and when 15 cm. long. As regards the relative use of scales and otoliths for determining the age it must be admitted that we do not as yet have a reliable method of differentiating between the true and false growth rings on the otoliths.

Sardinella fimbriata often appears in large numbers alone and with S. *longiceps* and, in fact, it has been the dominant sardine of the Malabar Coast ever since the Oil Sardine has diminished in numbers. It is smaller in size than the former, less valuable as a source of oil, and less esteemed as food. On the South-east coast India shoals of *Sardinella gibbosa* have been encountered. Most of these species of *Sardinella* have a wide distribution on the Indo-Pacific areas; both S. *longiceps* and S. *fimbriata* are mentioned by Delsman for the coasts of Java and, are probably of economic importance on the Malayan Coast. The white Sardine *Kowala thoracata* is another shoaling species noteworthy on the west coast of India.

THE ANCHOVIES

The Anchovies belonging to the genera *Thyrsa* and *Stolephorus* are essentially warm water fishes. The European species *Stolephorus encrasicholus* is common in the Mediterranean, the Channel and in Southern North Sea, where it is a migratory fish and apparently the length of life does not exceed three years.

In the Indo-Pacific area there are numerous species of *Thyrsa* and *Stolephorus*. Like other clupeids they are small in size and appear in shoals. From Indian waters alone about forty five species are known of which *Th. mystax, Th. purava, Th. telera,* S. *commersonii* and S. *tri* are the most important. The last mentioned is known to occur in shoals on the southern tip of India contributing to a summer fishery in the Cape Comorin area and up to the Gulf of Manaar and in many other regions on both the East and West coasts of India.

Delsman and Hardenberg have contributed much to our knowledge of these species in the waters of Java. They have shown that these species are essentially coastal in character and can survive considerable reduction in salinities.

THE MACKEREL

The mackerel is one of world's most important among commercial fishes. Only a few species of the true mackerel exist (unlike the numerous species and races among clupeids), and they are found in all temperate and warm waters of the world except in the Atlantic seaboard of temperate South America. In general the mackerels are gregarious, and essentially warm water species, occurring in large numbers not far away from the coasts and feeding entirely on plankton organisms. Even though widely distributed, they contribute to large scale fisheries only in certain parts of the world, partly because the shoals frequent certain regions which are definite spawning grounds and partly because the fishery has been commercially successful only in certain coasts. The uncertainties in its movements are probably associated with its spawning cycle which has not yet been fully understood.

European & American Mackerel—Scomber scrombrus, the European mackerel, ranges from the south of Norway to the Canary Islands and also in the Mediterranean up to the Adriatic. It is considered that the species found on the Atlantic coast of N. America is the same species extending in range from the coasts of Labrador to Cape Hatteras. Geographical races may exist in the mackerel as in the herring, but they do not seem to have been established. *Scomber colias*, the Spanish mackerel is of economical value in S. Europe, S. Africa and Japan and on the Pacific Coast of America, Gulf of Mexico and Gulf of Maine. The Pacific Mackerel, *Pneumatophorus diego* occurs in large schools from the Gulf of Alaska to the Californian Coast and extending into the Californian Gulf; it is a large species of about 20″ length and is caught throughout the year with a main fishing season from September to December.

Species of commercial importance in India and the Far East are now considered to belong to a different genus, *Rastrelliger*, the Indian mackerel being *Rastrelliger kanagurta* (Ruppell) called the striped mackerel by certain authors and enjoying a wide distribution from the coast of Natal in S. Africa to the China Seas. This species is smaller in size than the European mackerel, being of an average length of 7″-10″ as against the size of 12″-16″ for the cold water species. It is however, the most important single species of fish among warm water marine forms, and accounts for about a fifth of the total production of marine fish in India and Pakistan. It is needless to add that owing to its large numbers and the existence of well developed fisheries in many places in the Indo-Pacific area, we have in this species an object for close study where international collaboration would be most fruitful.

Indian Mackerel Fishery—The mackerel fishery is concentrated along the South West Coast of India from Bombay in the north to Travancore in the south and more especially on the Konkan and Malabar coasts. Karwar, Ratnagiri, Malpe, Tellicherry, Calicut and Cochin are mackerel fishing centres of great activity. To the south of Cochin the fishery dwindles in importance and almost completely disappears near Quilon. It is significant that mackerel are of no importance in fishing centres near Cape Comorin the southern most part of India which otherwise is one of the richest fishing grounds. On

the Eastern seaboard of India, it would appear that mackerel are known to occur in small numbers but there is no fishery devoted to mackerel. The same appears to be the condition in the Persian Gulf where according to Blegvad (1944), this species does not seem to have much commercial importance. The published works of Delsman and others on the fisheries of Netherland East Indies seem to show that even though the mackerel are fished in considerable numbers in the Java Seas, they do not seem to occupy the high place in the commercial fisheries there which they do in the South West Coast of India.

Migration of European Mackerel—It has already been mentioned that much of the irregularities in the movements of the mackerel are probably associated with migrations and spawning about which we at present know so little. The European species has been the subject of numerous investigations and it is now known that in Europe the mackerel fishery exists in both a pelagic and a demersal phase. Much new light on this problem has been thrown by the Plymouth mackerel investigations led by Steven (1949). In the English Channel and the Celtic Sea the very young mackerel remain on the sea floor during the winter months (November to December) in intensely dense patches, distributed over wide areas; these slowly disperse during the succeeding months and begin to spread to new grounds, yet remain near the bottom till about February. Pelagic shoals of juvenile fish begin appearing from January onwards, but it soon becomes an active migration of fish (Jan.-July) to the spawning ground which lies far outward to the west of the Scilly Isles on the edge of the continental shelf or the 100 fathom contour. Having discharged the spawn the shoals break up and disperse around all coasts (June to October) finally to disappear from surface waters and return to the compact demersal phase so characteristic of winter months.

The life history of the mackerel as narrated above postulates a new attitude to the problem of migrations of this fish which has hitherto been considered as purely one of off-shore fish coming inshore to breed, because migration to the spawning centres might involve movements in both directions, depending upon whether the winter packs of fish are situated outside to the sea or inside to the shore of the spawning ground. Steven (1949) and Corbin (1947) have been able to show this convergence to spawning ground from their examination of mackerel from different areas and of the abundance of eggs in the plankton. It is presumed that much of the confusion in interpreting the movements of mackerel has been caused by the thought that migrations can only be either off-shore or shorewards. Further, diurnal vertical migrations are noticed when fish begin to disperse from the compact winter groups to form pelagic shoals, the fish coming to the surface at night and descending to the depths by night. The spawning activity itself is spread considerably both in point of time and space, schools of spawning mackerel seem to arrive in a series of batches from different areas. In conjunction with this should be noted the fact that the ovarian eggs mature and are shed in successive batches over an extended period, there being no stage when the ovary might be called fully ripe or fully spent as observed in many other species of fishes.

Biology of Indian Mackerel—In regard to the Indian species, nothing is known about their movements beyond the fact that large pelagic shoals appear during the October—January period, sometimes extending even as late as March, and it is this phase which contributes to the fishery which is both inshore and pelagic. A full picture of its distribution will depend on the location of spawning grounds and the discovery whether there is any deep-sea mackerel existing in off-shore regions of the coast. From the observations of Devanesan (1942) it seems probable that spawning ground exists off the Malabar coast and that the occasional mackerel eggs seen at Quilandy and neighbouring places are only from the fringes of the main spawning area.

Other species of the mackerel in the Indo-Pacific are *Scomber neglectus*, *S. brachysoma*, and *S. janesaba*, probably all of these fall within the genus *Rastrelliger*.

Seer Fishes—The Spanish mackerel of the American coast, *Scomberomorus maculatus* is closely related to the seer fishes found in almost all tropical seas. All these species are now placed in the genus *Scomberomorus*, instead of *Cybium*, to which *genus* they are frequently referred. They often swim in schools but do not form shoals like pelagic fishes. Day recognises five species in eastern waters of which *Cybium guttatum*, *C. kuhlii* and *C. commersonii* constitute the Indian seer fishes which are highly esteemed as food.

C. guttatum is the commonest species, and according to Delsman it is said to frequent the river mouths in the Java seas, eggs having been found near the lower reaches of the rivers. *Scomberomorus maculatus* enjoys a wide distribution on the American coast ranging from Cape Cod to Brazil on the Atlantic and from San Diego in California to the Galapagos on the Pacific coasts. All species of *Scomberomorus* are believed to be migratory.

Ribbon fishes & Bombay Duck—Along with the scombroids must be mentioned the species of *Trichiurus* popularly called Hair tails or Ribbon-fishes which appear in large shoals on the Coromandel coast of India from September to January. Being ribbon-like, they are particularly suitable for drying. *Trichiurus haumela* and *T. savala* are two common species found throughout the coasts of India and Java; both are voracious feeders and their food often includes a wide variety of organisms probably indicating that they are not necessarily pelagic in habit. The factors governing their movements are not understood but they are probably oceanic. *T. lepturus* is known to enter colder waters from the tropical Atlantic. The Bombay duck *Harpodon nehereus* although belonging to a very different family of fishes may be conveniently mentioned here as it appears in shoals from the Gulf of Cambay to Bombay on the West Coast of India; this also is not a pelagic species, but shoals show a preference for shallow areas with a muddy bottom.

TUNNIES.

The Tunnies, Albacores and Bonitos are large Scombriform fish, of actively predaceous habits, distributed over almost all the oceans. They are active swimmers and often pursue shoals of pelagic fish on which they feed, particularly the Clupeids and mackerel, for long distances. *Thunnus thynnus* L. is the tunny of European waters (or Blue fin Tuna of the Pacific) migrating to the North Atlantic and colder waters in summer. As a fishery, this species has the highest importance in the Mediterranean. Schools of this species have been encountered in different parts of the world and in almost all oceans.

On the American coast the tunnies are usually known by the term "tuna". Several species are present on the Pacific coasts, especially in California where considerable numbers of the Blue fin Tuna (*Thunnus thynnus*) which is believed to be the same as the European tunny, the yellow fin tuna (*Neothunnus macropterus*), the bonito (*Sarda lineolata*) and the skipjack (*Katsuwonus pelamis*) are landed. The skipjacks are not really tunnies, but belong to the same group as the seer fishes.

Tunny fisheries of considerable magnitude exist in the Philippine waters south of Mindanao. These are described in detail by Domanty (1940). The most abundant is *Katsuwonus pelamis* (*Lin.*) which also occurs in large numbers in Japanese Seas. Next in order of importance are *Neothunnus macropterus Euthynnus yaito, Auxis thazard, Parathunnus sibi, Neothunnus ltosibi* and an undetermined species of *Neothunnus*. *Katsuwonus* and *Neothunnus* are said to be the most satisfactory for canning. The peak period for fishing is May, it is interesting to note here the practice of employing live bait composed of clupeid species for the capture of tunas.

Physiologically, the tunny is of the greatest interest because it is unique among cold blooded vertebrates in maintaining a body temperature higher than the surroundings. Information on the biology of the tunny has been summarised by Russel (1934). The eggs are pelagic, and growth is extraordinarily rapid; young tunnies growing to 300—500 gms from June to September. They probably mature at the end of the third year when they have attained nearly a metre in length and weigh about 15 kg.

They are omnivorous feeders mainly on pelagic fish but their stomachs have been found to contain also gadoids and other fish, squid and crustacea. They spawn in summer in the southern European waters. Migrations of the tunny are very difficult to explain. Various theories have been put forward, but it is believed that their movements are governed largely by temperature and salinity. There is also evidence that the catches are poorest in those years when the rainfall has been heavy.

On the Indian coasts our knowledge of the relative abundance of the tunny is extremely scanty, but they are known to appear in shoals near the Laccadive and Maldive Archipelagoes and in the Andaman Seas. Young tunnies are landed in large numbers all over the West Coast of India—more especially between Trivandrum and Cape Comorin during the North East Monsoon period i.e. October to November.

HORSE MACKEREL & SILVER BELLIES.

In the Indo-Pacific areas the Carangid fishes form important pelagic fisheries. The genus *Caranx* includes several species (for India 26 species are listed by Day) and most of them are small in size but the more important species from the commercial point of view, like the horse mackerel, *Caranx crumenophthalmus* attain a length of a foot. On the west coast of India, this fish appears in large shoals during the months, September to October. Numerous species are also known from the Java and Malayan waters. The Jack mackerel of the Californian coasts, *Trachurus symmetricus* is a schooling fish of importance in the tropical Pacific, often obtained along with the Pacific mackerel.

Members of the family *Leiognathidae* often appear in small pelagic shoals in tropical waters. Species of *Leiognathus* and *Gazza*, often not exceeding a size of 4 inches in length, are caught all along

the Indian coasts. They are valuable because they are fished mostly in summer months when the more important pelagic species are not available in coastal waters. *L. splendens, L. ruconius* and *L. insidiator* appear in shoals of considerable magnitude on the Malabar coast, at Madras and near Rameswaram Is..

The pomfrets, which are species of *Stromateus* may also be mentioned here. Although they cannot be called pelagic fishes, they are not demersal like sharks and rays and are often caught in seine nets along with many other pelagic species. *Stromateus niger* (the black pomfret), S. *cinereus* (Silver pomfret) and S. *sinensis* (White pomfret) are fishes which grow to about a foot in length and are the most popular among Indian fishes. They do not seem to form shoals but probably move about in schools. At present we know nothing of their habits and bionomics. Other fish in the same category are species of *Lactarius sciaena* and *Polynemus*.

FLYING FISHES.

The Flying fishes (Family *Exocoetidae*) are oceanic fishes found in the warmer waters of the world; they are wholly pelagic and gregarious. As is well known, the chief peculiarity lies in the enormous development of the pectoral fins which help the fish to glide in air. Numerous species have been recorded (7 from Indian waters) but information is lacking whether the species show any definite geographical distribution. Similarly, we have not been able to find the areas where they are exploited as a fishery, with the exception of the Coromandel coast of India between Cuddalore and Point Calimere, where during summer months (May—July) *Cypsilurus poecilopterus* and *Cypsilurus* sp. appear in shoals, advantage being taken by fishermen of the spawning habits of the fish. Bunches of leaves and twigs are laid a few miles away from the coast and around these the fish congregate to deposit the eggs. According to Delsman (1924) a similar method of catching flying-fish exists near Makassar in Celebes, where shoals make their appearance from July to October. Shoals have also been noted near Barbados in the West Indies.

GENERAL OBSERVATIONS ON THE BIOLOGY OF FISH CONTRIBUTING TO PELAGIC FISHERIES.

It may be worth while now to summarize some of the general features concerning pelagic fishes. Among their common characteristics may be mentioned their gregarious habits—swimming either in large shoals like the clupeids or in schools like the Spanish mackerel—but members of a shoal mostly belong to the same stock and brood. The shoaling forms are primary consumers of plankton—both vegetable and animal—and have efficient straining apparatus for the collection of food. They do not seem to exercise any selective faculties in the choice of food except that determined by the stratum of water in which they pursue their food. Variations in food often depend upon variations in plankton, i.e. in organisms according to the season. The larger pelagic fish like the tunny are very selective feeders and their movements are often determined by the movements of species on which they are said to feed. From the nutritional point of view, pelagic fish fall within the early phases of the food cycle of the sea; they are either plankton predators or are forms depending upon such predators for food. This relationship to plankton productivity is a direct one unlike the demersal fishes whose utilization of plankton is an indirect one based on the food cycle of benthic organisms. A direct correlation between plankton and the abundance of pelagic fisheries composed of clupeids and the mackerel should therefore be possible. As plankton productivity is closely dependent upon the nutrients available, the shoaling fishes depending on plankton should show a demonstrable positive correlation between their abundance and suitable available chemical contituents of sea water. Russell has shown a close relationship in the English Channel between the abundance of fish larvae and the amounts of phosphates available in the preceding winter (see Harvey 1945). The experiments of Gross and collaborators (1944) in Scotland have shown increased plankton production followed by higher population of species composing the bottom fauna as a result of artificial addition of phosphates and nitrates into the enclosed arms of the sea, and in a recent paper, Cooper (1948) has been able to establish a correlation on the lines of Russell's data, between the phosphates and the landings of elasmobranch fishes at the Channel Ports. It is possible that reliable hydrographic and plankton data for tropical coasts may help us to understand some of the irregularities in time and place of the appearance of shoaling fishes.

While a rich plankton is usually fruitful in that it is followed by an equally rich succession of organisms that subsist directly or indirectly on the plankton, there are instances when certain species of planktonic organisms multiply and increase in such colossal numbers that they are harmful to the normal productivity of the sea. Such are the instances of "red-water" phenomena noted in many warmer coastal waters of the world which are produced by dense swarms of dinoflagellates. A similar planktonic imbalance may be caused by enormous increase

in numbers of the blue green alga *Trichodesmium* (Oscillatoria). It is known that "red-water" phenomena are inimical to fisheries because shoaling fish do not frequent such patches, and on the Indian coasts the fishermen have learnt to avoid such patches. Hardy (1924, 1926, 1936) in a series of investigations with his plankton indicator showed that there was a regular scarcity of the herring where *Phaeocystis* or diatoms of any kind were present in considerable numbers. There are many comparable instances in the distribution of planktonic species to explain which Hardy developed his theory of "animal exclusion". Lucas (1947) has recently reviewed the evidence relating to these and related phenomena and suggested that these relationships are best understood as the ecological effects of external metabolites produced by planktonic organisms, and that most of these mutual exclusions of organisms are brought about by the agency of these metabolic products liberated into the sea. There is also evidence to show that certain metabolites are beneficial, a view that is widely accepted in micro-biology. Plankton abundance and its influence on fisheries would also be thus regulated by these *"ectocrine"* factors caused by the abundance of individual organisms.

Pelagic shoaling fishes usually have a shorter span of life than demersal species. The tunnies, the sword fish, and the larger species would no doubt live for many years, but clupeids and mackerel which provide the bulk of the catches have only a few years growth as contrasted with demersal species. Even here, the European herring is the longest lived, the full sized individuals are at least five years old, closely followed by the mackerel, which has a minimum age of 3—4 years, but in the tropical shoaling species, it would appear that most species do not live for more than two to three years*. Forms like *Sardinella longiceps* and S. *fimbriata* probably have short spans and the smaller species have probably shorter lengths of life. If we are to go by the size of fish and the rapid growth under tropical conditions, where the rate of metabolic activities increases at least three times what it is in colder latitudes, the maximum size to which most species grow may be attained within the course of 10—12 months. Hardenberg's (1938) observation that most species of fish attain a length of 10—15 cm. during a period of seven months or less is noteworthy in this connection.

This rapid development along with the fact that spawning may take place at different periods of the year makes division of stock into year classes a matter of great difficulty and, as Hardenberg has rightly pointed out, many of the methods in fishery research widely adopted in colder waters have only a limited application in tropical waters.

The eggs of almost all the species of shoaling fishes are pelagic, with the notable exception of the herring where it is demersal. The flying fishes on the other hand which are pelagic and even oceanic in habits have pseudo-benthic (demersal?) eggs which they attach to floating woods. Details of development of the tunnies and sword-fish are unknown. We are largely indebted to Delsman, who has studied the eggs and larvae of fishes from the Java Seas for many years, for our knowledge of the development of many of the Indo-Pacific pelagic species.

It is well known that owing to the constant availability of plankton and other food and fairly uniform conditions of temperature in tropical waters, marine animals have extended spawning periods. Many naturalists, mainly influenced by the observations of Semper, have been inclined to think that sexual periodicity is completely absent in tropics and that species breed, and produce eggs and larvae at all times of the year. While this is true for many invertebrates with a short span of life, recent work has brought evidence to indicate that either definite spawning periods or intensive peak periods in spawning are present even under tropical conditions. There is, however, one significant difference in that mature or nearly mature sexual products are present in most tropical species at most times of the year—a behaviour very much in contrast with cold water species.

Spawing seasons in the warm water species are nevertheless conditioned by external factors like suitable salinities and temperature for the dehiscence of the sexual products and availability of food and favourable environs for the growth of the young. Consequently even though a primary periodicity based on internal rhythms tends to become obliterated, a secondary periodicity based on changes in environment is often noticed.

It is at present difficult to assess how far this general observation will be applicable to pelagic fishes. Promiscuous breeding is seen in certain species. In most cases, periodicities in occurrence are observed but some of these can be correlated with migrations due to rainfall and monsoon conditions and the possible influence these have on reproduction. According to Hardenberg (1938) species of *Decapterus* (*Caranx*) are brought into the Java Sea with the

* *Chirocentrus dorab* among the clupeids which is, strictly speaking, not a shoaling fish, must be a notable exception as it grows to about 100 cms. in length.

Eastern monsoon currents from Flores sea and this stock is driven back with the change in current. A new stock of *Decapterus* enters the Java Seas from the South China Sea in the north and from the Indian Ocean in the south. The changes in direction of winds and currents and in the rainfall which is seasonal often result in sharp changes in coastal salinities. Delays in the onset of monsoons on Indian coasts are often followed by delays in the fishing seasons for sardines, mackerel and many other shoaling fish. In regard to coastal fish inhabiting brackish tracts, there is evidence that the rains act as a stimulus to spawning. It is possible that changes in salinity may likewise act on coastal fishes. In this connection the general observation made by Delsman from his study of fish eggs and larvae in the Java seas is pertinent. He says that the favourite spawning places of those pelagic fish are these where the ocean water of high salinity and the coastal water of low salinity mix and where the salinity begins to decrease and where the places are at a safe distance from the coast so that the waters will not be liable to coastal pollution. Shallow waters are avoided, and for most species it was also found that spawning takes place at night.

CONCLUSION.

In this brief review we have attempted to bring together the salient features controlling the pelagic fisheries of the world together with an account of the biology of these fishery resources. We are aware that it has not been possible to bring together in this account a large part of information that is already available in the publications scattered all over the world, but it is hoped that the more important aspects have been indicated in broad outlines. We are in need of more definite data relating to Indo-Pacific species before we can have a satisfactory picture of our pelagic fisheries and we submit our observations with the hope that these may form a starting point for discussion by many of you assembled here who have a closer knowledge of the fisheries in this area than we have.

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See also Nos. 4, 8, 11 and 17 on page 123.

METHODS OF BIOLOGICAL RESEARCH ON PELAGIC FISHERIES RESOURCES

by Oscar E. Sette

Fishery biology, which may perhaps be defined as the study of fish populations as resources for use by man has grown, almost during our lifetimes, into a practically full-fledged scientific discipline. Pursuit of research in this field requires a system of observation and analysis using a combination of skills as distinct from those of other branches of biology as are the techniques of bacteriology or genetics. Its principle flaw to this claim is a lack of its own text and handbooks. Even now there are signs of filling this lack. I may refer to Kesteven's (1946) "A procedure of investigation in fisheries biology", Ricker's (1948) "Methods of estimating vital statistics of fish populations", Thompson's (1937) "Theory of the effect of fishing on the stock halibut", and Russell's (1942) little book "The overfishing problem" as indicative of what might be chapters in a future text—or handbook.

A full review of methods of research on pelagic fishes would include all chapters of such an hypothetical future text on fishery biology, for I can think of no aspect of research in fishery biology which would not have its bearing on the study of pelagic fish and fisheries. It is manifestly impossible to produce here the text book of tomorrow and I shall not attempt to do so.

In some twenty-odd years of personal study on certain pelagic fishes, principally the mackerel of the Western North Atlantic and the pilchard or sardine of the Western North Pacific, with nearly as many years of sharing with others the problem of selecting and devising methods of research on fishes of the inshore and the demersal groups, I have become not only impressed by the difficulties in studying the pelagic group, but almost obsessed with the need to devise new techniques and approaches.

This is my apology for emphasizing the defects and inadequacies of existing methods at the cost of neglecting some of the very indispensable but thoroughly conventional elements that must form the major part of any well-balanced programme of investigation. For the latter I refer you again to Dr. Kesteven's paper.

I shall take it for granted that the ultimate objective of fishery research is to find out the potential productivity of a fish population serving as a food resource. That is, we are interested in the populations, not the individuals, and we are interested in the population's capacity to replace the added mortality imposed by fishing. Moreover, we would like to know how high this added mortality can be raised to produce the maximum amount of food and still be replaced by the natural powers of regeneration of the stock. Clearly, this is a matter of birth and growth rates, balancing losses through fishing and from natural mortality and we may use

the term population dynamics to designate the subject.

The study of population dynamics has received considerable impetus in recent years through the formulation of theory concerning the reaction of fish populations to the strains of fishing. A whole series of papers has been published, beginning with Baranov (1918, 1925) and followed by Russell (1931), Thompson and Bell (1934), Graham (1935, 1938), Thompson (1937), Silliman (1934), Ricker (1940, 1944, 1948), and others. The theory, expressed largely in mathematical terms, is now so well-developed that, given certain suitable fishing records and suitable samples of the catch, one can compute the natural mortality, the fishing mortality, the recruitment, and the numbers in the total population. Where it is possible to conduct tagging operations and get returns on a sufficiently quantitative basis, similar computations are possible. It is my opinion that the theory is so far advanced that the great problem now is to get the suitable fishing records and the suitable samples of the catch or to conduct proper tagging programs or both.

All of this is, I think, so difficult for pelagic fish populations that the application of the modern concepts of population dynamics to most pelagic fish populations must await further progress on the more rudimentary features of the problem.

RACES OR SUB-POPULATIONS

First of these is to find out whether one is studying a fishery based on stock of fish that is homogeneously mixed throughout the range of the fishery or whether there are several independent populations involved. Two techniques have wide use in the study of races and migrations, and both have been applied to pelagic fisheries. They are morphometrics and marking. Both have inherent difficulties and limitations when applied to pelagic fishes.

Morphometry: I am taking the liberty of including under the term morphometry, the counting of metameric parts, such as vertebrae and fin rays, as well as measurements of form and parts, such as depth, girth, head length, and location of fin insertions. Perhaps the most serious difficulty in applying this technique to pelagic fishes is the sampling problem. With members of the herring family (Clupeidae), it has been found that successive samples from the same locality differ significantly from each other with respect to a character under examination. In some instances the reasons are apparent. For instance, with the Alaska herring (Rounsefel and Dahlgren, 1932), the Pacific pilchard (Clark, 1947), and the European sardine (Navarro, 1948, pp. 322 to 325), it has been found that vertebral number differs significantly among the year-classes. Where this occurs and where the fish are segregated into schools according to size, a sample from one school will be significantly different from those of another school if the latter is made up of predominantly different sizes and hence ages.

Other elements than year-classes and other characters than vertebrae may equally well cause significant differences between samples drawn from different schools of the same population. With schooling fish, therefore, it is suggested that very serious attention be given to the design of sampling before investing the considerable time demanded by the counting or measuring of parts. Many small samples are more likely to lead to sound conclusions than a few large ones.

However well the investigation may be designed, the study of races by the morphometric method has a more serious drawback. If one gets negative results, it does not necessarily prove that the population studied is homogeneous. It only means that characters studied are indistinguishable. To me this defect seems especially serious for pelagic schooling fishes. The individuals in such a population must conform with its companions in all its important activities. To a greater degree than in other populations individual variations, arising through mutation and affecting the individual's ability to compete with its companions, probably, end to be lethal and to be eliminated immediately. In other words, differences have little chance to arise and be perpetuated and studies based on finding differences are likely to yield negative results. As an example of this, morphometric studies by Amemiya and Tamura (1943) have failed to reveal characters of the Japanese sardine that differ more from the California sardine than the differences found within the stocks on each side of the Pacific, even though there is no reason to believe that the stocks of pilchard or sardine in the two sides of the North Pacific intermingle.

It is desirable, therefore, to apply other methods of research either in lieu or in verification of the morphometrical studies.

Marking: Of the several methods of studying independence of fish stocks, the methods of marking or tagging have the advantage of affording direct evidence and also under favourable circumstances can yield other important information, including estimates of mortality and population size.

Unfortunately, practically all of our pelagic fishes are either difficult to mark or tag, or there are difficulties in recovering the tags, or both.

Some experiments conducted at our Fisheries Station at Woods Hole, Massachusetts, by R. A. Nesbit and myself in 1932-33 are of interest in this connection. Only a portion of the results of these experiments has been published, and it may be appropriate to give a brief summary here of some general conclusions we reached from marking and tagging various marine fishes by applying various marks and tags in various places on the fish and holding them in aquaria, live-cars, or in a large outdoor salt-water pool. We found that initial mortality after placing the fish in enclosures, with or without tags, ranged from negligibility in sedentary fish like flounders (Pleuronectidae) to moderate in the case of active semi-pelagic fish like the croakers (Sciaenidae) to extreme in the very active and truly pelagic fish like the mackerel (Scombridae). After the initial mortality extending through about two weeks there was no further severe mortality even from the rehandling of the fish for attaching tags. Marking with a tatoo needle, using various pigments was unsatisfactory, some pigments reacted with sea water to become invisible, others soon faded out, and still others, though permanent, tended to become redistributed in the tissues, forming only blurred, unrecognizable blemishes. External tags, however and wherever attached, caused some injury and the injury was progressive throughout the experiments. The injury was least and progressed more slowly the more nearly the tag was attached to the part of the body with minimum motion. Attachment on the tail or caudal peduncle was the least desirable place, on or near the immobile parts of the head the most desirable. We presently became convinced that even the best externally attached tags had only limited usefulness and eventually either would migrate through tissues and drop off or would cause the death of the fish in the matter of some months when used on active fish.

As this became clear, Mr. Nesbit conceived an idea that seemed to him so fantastic that he did not divulge it even to me. He fashioned some strips of flat celluloid about 1/4 inch wide by 3/4 inch long. One evening when no one was around, he fished some scup (Sparidae) out of an aquarium; with a scalpel he made a 1/4 inch incision in the belly wall, and with forceps pushed one of his celluloid strips through the incision into the coelomic cavity of each fish and returned it to the aquarium. He was agreeably surprised to note that there was little bleeding and the tonus of the belly wall musculature closed the incision. He was even more surprised to find on return the next morning that all of the fish were not only alive, but seemed none the worse for the treatment—and so they remained until the aquaria were shut down at the end of the season. From this, Mr. Nesbit went on to experiment with internal tags for a number of more delicate species such as fingerling squeteague (Sciaenidae), and I ran a test on mackerel (Nesbit, 1933; Sette, in press). We both found that incisions healed perfectly and no perceptible internal irritation or inflammation resulted. Mortality and growth of the internally tagged fish did not differ from the controls.

The internal tag now appears to be the one tag that is permanent and harmless to the fish. There are difficulties in securing returns from field experiments since the tags are not found until the fish are opened for cleaning and then the tags are often so covered with mesenteric tissues that they escape notice.

However, a certain amount of ingenuity may be employed in connection with securing returns. Dahlgren (1936) used the internal tag in the Alaska herring fishery. There the catch is fed into fish meal plants by the ton without any individual handling. One would consider this the most unfavourable situations in which to recover tags. However, Dahlgren used nickle-plated steel tags and by installing electromagnets in the meal chute, captured the tags out of the processed products. This had certain disadvantages and he later employed an electronic tag-detector, which automatically searched the fish for tags as they passed along a chute going into the plant.

Other schemes may be employed in other situations. Where fish are individually gutted and cleaned by hand in large or small numbers at many localities, and a small strip of plastic or metal would be overlooked, there is a number of possibilities for rendering the tag more conspicuous.

Regardless of the detailed mechanics of tagging and recovering, when tagging is used to study the independence or inter-relations of widely ranging pelagic fish, there is the necessity of securing concerted and co-operative action by the people of a number of different countries or governments. Organizations such as this Indo-Pacific Fisheries Council may be the instrument for accomplishing this.

Results of tagging experiments sometimes are difficult to interpret. Some years ago I had a curious experience with the Atlantic mackerel. In 1925, under the auspices of the North American Council on Fishery Investigations, the Governments of Canada and the United States embarked on a co-operative mackerel-tagging experiment, and it fell to my lot to supervise the United States' part of the tagging experiments and to collate and interpret the results therefrom.

Some thousands of tagged fish were released along the Canadian and United States coasts, and some hundreds were re-captured. But anomalously, the Canadian tagged fish were re-captured off both the Canadian and United States coasts, whereas the United States tagged fish (with one exception) were retaken off only the United States coast. A number of hypotheses might be offered to explain this anomaly, but of all that were considered, none could be accepted, because either lack of evidence by which to test it or of the existence of contrary evidence. This confusing result, coupled with obvious harmful effects of the tag on the fish, led to the abandonment of the experiment after several seasons of tagging.

In the meantime, an intensive investigation of the United States fishery was going forward and among other things, it included the measuring of the lengths of mackerel in the landed catch. As the data accumulated over the years and were studied in the form of curves of frequency distributions, it gradually became apparent that groups of these curves had distinctive features which followed a regular pattern of seasonal change. On the basis of ten seasons of daily records on size-composition and locality of catches it was possible to construct an hypothesis of migration that accounted for these facts. In brief, the mackerel migrated in two contingents, a southern contingent approached the coast well to the south and then travelled northward but not far enough to reach waters off the Canadian coast, while a northern contingent approached the United States coast somewhat later, somewhat farther north, and continued on into the waters off Canada to spend the summer, returning again through waters off the coast of the United States in the autumn.

Once having arrived at a solution of the problem through study of size-composition, it was easy to see why the tagging results of some ten years ago had seemed anomalous. A review of the records showed that all but one lot of fish in the United States part of the experiment had been tagged at a time and place and were of a size-composition appropriate to identify the fish as members of the southern contingent. As such they could not be expected to show up in the Canadian fishery. The one exceptional lot was from a place, at a time, and of a size-composition appropriate to contain a mixture of both northern and southern contingent mackerel. This lot yielded the single Canadian return from all the mackerel tagged off the United States coast.

Whether studies of the size-composition of pelagic fish generally would be a successful technique is difficult to judge. Success in the instance just related depended mainly, I think, on the existence of fluctuations of year-class strength which produced the distinctive features of the frequency curves, it depended on a fishery that well covered a substantial portion of the stocks during their periods of migration and it depended on a sampling system of a design and magnitude capable of submerging the effects of a size-selective schooling. Not all of these elements are likely to be present in a given situation.

It is probably a general truth, however, that any particular method of studying races and migrations is likely to be so indecisive as to require the employment of a second technique for purposes of verification.

I have dwelt perhaps over long on the study of races and migrations not only because of the indispensable necessity of knowing the limits of the population or groups of populations on which a fishery is based, but also because practically all other phases of research are likely to be confusing until the population relationships are clarified. Also, this is a field in which there is need for international collaboration such as this Council is set up to provide.

Unfortunately, it has consumed so much time that the remainder of the research field must be touched only very lightly.

FLUCTUATIONS.

We must touch on fluctuations because of their prominence in pelagic fish populations. Also, they are the most serious obstacle to the application of methods of studying the dynamics of fish populations. They may have their basis in real changes in abundance in the stock of fish itself or only changed in the relative success with which the fish elude the fishermen. The latter type I shall call fluctuations in availability.

To reduce the fluctuations to a form in which they can be studied, fishery biologists have adopted almost universally the *rate of catching fish*; that is, the average quantity caught per unit time per unit gear operated. This eliminates the effect of varying amounts of fishing and allows attention to be centred on the changes in the population or its availability. It has the further advantage of not requiring full and complete records on all of the catch. A sample only is necessary. And the sample usually is comprised of a group of fishermen or fishing vessels consistently fishing a single type of gear in a certain area over the period of years under considera-

tion and for which the records have been or can be obtained. Where skippers of fishing vessels are accustomed to keeping log book records or can be persuaded to do so, these comprise the best data because they consist of records made at the time and have, or can be designed to have, the pertinent details of the vessel's activities recorded.

There are various problems in choice of units and methods of computation which we have not time to discuss. One very elaborate treatment on a pelagic fish has been reported by Silliman and Clark (1945) and may serve as an example of the complications which arise.

The catching rate based on such records and computations have been explicitly or inferentially considered as proportional to the density of the fish in the area fished and have been commonly accepted as indices of abundance. With pelagic fishes, however, I prefer to use the term "*apparent* abundance" since catch is not only in proportion to the density of the fish in the area but also to the *availability* of the fish in the area as a consequence of the type of gear used and the manner in which the fish are distributed within the area, the way the fishermen or their gear are distributed in the area, and the way the fish react to the fishing activity.

To digress a moment, it obviously would be desirable to have some way of estimating abundance that would be free of the availability influence. This would be particularly valuable in surveying new areas where there is as yet no fishing. Some years ago I personally investigated the possibility of estimating abundance by searching for the schools of pilchard from aeroplanes off southern California. This proved even less reliable than actual fishing, for good catches were made by the commercial fleet in areas where no sign of fish could be seen from the air. Although this is explicable from the fact that the air scouting took place by day and the fishing by night, it still proves that pelagic fish schools cannot always be reliably located from air. For other fishes in other areas it may well prove more successful. For instance, an air scouting service for the pilchard fishing off Washington coast where fishing is done by day proved very helpful. Its use for estimating abundance was not tested, however. Also I have seen some excellent aerial photographs of tuna in Australian waters.

Another possibility, meriting trial, is the use of sonic gear to detect fish schools. This has been employed for surveys of herring schools in Norway (Sund, 1943), using a sonic sounding machine. Such machines can detect schools that are directly under the vessel. More complex types sending out a sonic beam in a lateral direction would enable one ship to search a much broader area sonically.

With both air observation and sonic detection, there are problems of species identification which have not been solved. Certainly the techniques have not yet reached the perfection required for estimating abundance reliably. We hope that the program we are initiating in the mid-Pacific may include some work in this field.

In the meantime, it appears that principle reliance for our estimates must be placed on actual fishing. These will be of *apparent* abundance, not actual abundance. How to distinguish one from the other is now one of the major problems in pelagic fishery research.

One type of fluctuation to which pelagic fishes usually are subject, is caused by fluctuations in year-class strength. This was ably demonstrated by Hjort and by Lea for the North Sea herring over 20 years ago (Hjort, 1926), and presumably is familiar to most of us. Some spawning seasons give rise to many offspring, others to very few. A successful brood or year-class when it reaches commercial age, by its abundance will produce good fishing for a number of years, until mortality cuts down its numbers, when poor fishing ensues until another successful year-class comes along. The nature of this penomenon marks it as a fluctuation in real rather than apparent abundance and its existence is detected by the size or age composition of samples from the catch. However, here again the sampling system is important, especially when the fishery depends on schooled fish, as for instance in purse-seining. Since the fish tend to school according to size and age, it is necessary to take many samples well distributed over time and area to get representative sampling. Many small samples are to be preferred to a few large ones. Data from the latter are likely to be very confusing indeed.

Even with ideal sampling, the fluctuations in availability may confuse the record and I believe that the solution of problems of availability now constitutes the foremost task with respect to pelagic fisheries. It is a field where progress has been very limited.

In a few instances, investigators have found correlations between fluctuation catch and conditions of sea and weather. To mention some of them, Thompson (1917), found a correlation between temperature and catches of albacore (*Thunnus germo*) off southern California, and there are several

instances where influx of certain species from the North Sea through the Kattegat and Skagerack toward the Baltic were found to be associated with corresponding extrusion into these areas of North Sea waters.

It appears to me that progress in this field depends on elaboration of suitable frames of reference. Two such frames probably are needed. One of these is a frame of reference in the time-space dimensions.

Without realizing it, we are prone to refer our observations to a topographical frame of reference. We use shore line, bottom contour or latitude and longitude as landmarks or as pegs on which to hang our data. These are significant to pelagic fish only to the extent that they influence the conditions of environment. The pelagic fish, living in or near the surface waters, often at great distances from land, probably are delicately adjusted to oceanographic conditions which are less intimately related to the topography than they are to the interactions between sea and atmosphere. We probably should relate the various observations on the fish to such things as currents, upwellings, thermoclines, convergences and divergences. These, of course, are ever-changing in time and space in contrast to topography, which is fixed. For studying and for developing pelagic fisheries, there is need for well-developed oceanographic programs, which not only describe the prevailing conditions, but record their departures from the prevailing pattern.

Along with the oceanographic programs we need to discover the reaction patterns of the pelagic fish to provide a frame of reference by which we may evaluate a set of oceanographic observations in terms of availability of the fish.

Methods of conducting studies in this field have yet to be devised. To the extent that it is feasible the experimental method of holding pelagic fish in captivity should be utilized. But undoubtedly the main effort will have to be work at sea in very close conjunction with the oceanographic work. Among the many questions to be answered are:

Under what conditions are schools formed?

What determines the size of the school and the size composition of the fish within the school?

How frequently are schools formed, disbanded, and reformed, and under what conditions?

What determines the level at which the fish are to be found?

Under what conditions are they fast-moving and elusive and under what conditions do they tend to loiter and to be easily caught?

What determines their routes of travel?

The availability problem will be solved, probably, by finding the answers to these questions, one by one.

As this is done, it will pave the way toward understanding the dynamics of pelagic fish populations. It should also greatly aid the practical fishing operations and relieve this activity of some of its vicissitudes.

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DEVELOPMENT OF PELAGIC FISHERIES

by J. D. F. Hardenberg

To give a symposium on the development of the pelagic fisheries in the seas under the auspices of the Indo-Pacific Fisheries Council is not an easy task, for the simple fact that almost everything has to be developed or in other words there are, according to me, almost no real pelagic fisheries in existence over here.

The bulk of the landed fish is taken in the close vicinity of the shores. Sometimes, it is true, the fishermen make long voyages at sea but this is only to get near another shore, may it be mainland or an island or group of islands and in this case they often market not in their homeport but somewhere else where the prices are higher.

In general it can be said that fishing outside a distance of 50 nautical miles from the nearest point of the coastline is an exception. The reason for this is obvious. It is not so much a scarcity of fish in the open sea as the fact that only a negligible part of the number of fishingcraft is motor-driven. All or almost all prahus, sampans, catarmarans, or whatever they may be called are sailing vessels, open sailing vessels, wherein the fish cannot be iced, cooled or refrigerated. This means that, should the fish be brought fresh to the market, the vessel has to return to its base port every day. It means therefore that the boats cannot go very far, the more so as they are dependent on the offshore and on-shore winds at night and day.

Only motor fishing vessels—mostly Chinese or European owned—stay out longer than twenty four hours as they can have ice in the hold. But these vessels too do not venture very far outside the old wellknown coastal fishing grounds, as they can get a sufficient catch there so there is no need for them to take hazards to go out into new and unknown fishing grounds, which economically might be a failure.

I have said above that the indigenous fishing is a coastal fishery. In a technical sense this certainly is true, so far as distance from the shore alone is concerned in the definition of the word coastal fisheries. Should one consider the technique of fishing also, then the situation is not so clear.

Fishing traps certainly belong to the coastal fishing and the amount of the landings from these in the various markets may vary from almost nil to about 80 or 90% in some cases. Thus for instance the landings from fishing traps in the market of Batavia are about 20% from the total catch, whereas the famous djermals in the Rokan Mouth near Bagan Si Api Api in the Straits of Malacca land almost the whole of the catch from this area. Nevertheless these djermals, which are nothing else but a kind of fishing trap, are found far out sea beyond sight of the coast, up to a distance of 40 nautical miles, and thus quite near the limit of the sailing vessels.

In a biological sense the fishery in the coastal belt certainly is not wholly a coastal fishery as many pelagic species are found within this zone of 50 nautical miles. Moreover the coastal belt parallel with the shore varies in width.

Near Bagan the 40 mile limit certainly lies within the coastal waters, near other coasts where we find a steep slope this zone is certainly much

narrower and is in some cases not more than a few miles wide.

Referring again to the situation at Batavia we come to the conclusion that somewhat less than 40% of the total brought to land depends on species with a pelagic biology.

The remaining 40% from the landings at Batavia not yet accounted for are derived by far the greater part from species living within the coastal belt of the sea and are taken with different methods and are therefore not of interest to us within the scope of this paper.

The number of species on which a pelagic fishery depends is small, especially for our tropical waters, when compared with the fauna belonging to the coastal fauna from reef, muddy or sandy shores.

Our pelagic fish here, as everywhere else in the world, belong to a few families only, viz: Clupeids (anchovies included), Carangids and Scombroids and some which are of lesser importance—at least up to this moment—as for instance flying fishes and dolphins and pomfrets.

Compared with seas from more temperate climates the importance of the above named groups is not the same. Whereas over there Clupeids are of the greatest importance, they are of lesser value here, due, no doubt, to the smaller amount of plankton in our waters.

What we know about their habits in these waters is surprisingly little, especially about their distribution in space of the sea. Near the coast of the shelf seas *Clupea (Harengula) fimbriata* and *Clupea (Harengula) perforata (Cant.)* are certainly the most common and personally I have the impression that they are much rarer near shores bordering deep water. However, one has to be very careful with conclusions in this respect, for most of the fishing is done thus far in our shelf seas and fishing methods are changing from place to place and as a result, the combination of species in the catch is also changing.

Species which are of importance to the pelagic fisheries, which have a true pelagic biology, therefore, are primarily *Clupea (Amblygaster) leiogaster* (C.V.) and *Clupea (Amblygaster) sirm (Rüpp.)*.

Furthermore the mysterious *Clupea (Harengula) longiceps* C.V., the so-called Oil Sardine, has some importance and it would be desirable to know somewhat more of its habits. This species appears at certain years at certain places by the million, only to disappear almost entirely after a few months.

The species of the genus *Stolephorus* are of importance too and in a double sense, either directly as human food, or indirectly as a bait-fish. Some species are strictly confined to the shore and live even in brackish water, others are confined to the salinity of open sea water and have the typical long slender forms of pelagic fish.

Here again it has to be said that we do not know very much about their distribution. How far they venture out in the sea away from the coast is not known, though probably it will never be very far.

Of much more importance than the Clupeids—at least in the regions which I know best—are the Carangids. But of the numerous species only two names need be mentioned, especially within the scope of this paper. These are the species belonging to the genus *Decapterus*, and *Caranx (Selaroides) leptolepis*.

About their distribution and biology something is known, here at least. *Decapterus* species do not live in water with a salinity less than 32.5‰ and it is especially in the vicinity of the just-named isohaline that *C. leptolepis* lives. A regular, but mostly unimportant bycatch consists of specimens belonging to *Caranx (Selar) crumenophthalmus* and sometimes *Elagatis bipinnaulatus*.

As I said, *Decapterus* live only in water with a salinity up to 32.5‰ and probably these fish can be found everywhere in suitable water. In the Java sea I have shown that the Decapterus swim to and fro in accordance with the changing salinities and that the stock of *Decapterus* consists of three components derived from a different source, parts of the South China Sea, the Indian Ocean and the Flores Sea, where the salinity is always higher than the required minimum to live in.

The bulk of the catch of *Decapterus* in Indonesian waters comes from the shelf seas—in this case primarily from the Java Sea. A rough estimate shows us that the landings from the Java Sea amount to 50,000—60,000 tons a year. The total catch of pelagic fish amounts to 80,000—90,000 tons. The difference of 30,000 tons in made up of Clupeids and Scomber species.

The genus *Decapterus* seems to occur everywhere in these seas, provided that the salinity is suitable. The genus as such lives in the shelf seas

as well as above deep water. How far it ventures out into the open ocean is unknown to me.

In literature five species of *Decapterus* are recognised for our waters. I doubt whether this is true. It is possible that some recognised species in reality are only one and there are certainly other species not comprised in the number of five mentioned above. I suspect even the existence of an Atlantic species over here but to discuss this is outside the scope of this paper and for various reasons it will not be an easy task to make my suppositions true.

However, several species do exist in our seas and at least one of them (*Decapterus kurra*) seems to be confined to shelf seas and coastal areas of deeper basins, whereas another one (*Decapterus macrosoma*), with a much more slender body than the first, seems to be much more an inhabitant of the open sea.

There is one very striking fact in the biology of *Decapterus* as far as we know it. Immature and young mature specimens live in higher waterlayers and seem to live in schools, and it is on these specimens that the fishery depends.

Full-grown individuals are never found in the catches and are only occasionally taken out of deeper water by hook and line.

Of a growing importance for the development of the pelagic fisheries in our region are the Scombroids.

Of the genus *Scomber* several species are known. One of these, *Scomber neglectus* v. Kampen, is entirely confined to the coast and seems to prefer a somewhat lower salinity. Another one, *Scomber kanagurta* Blkr. lives in about the same conditions as the genus *Decapterus* and in fact the two are often captured together. This species is often found in the water from the shelf seas, as well as above deeper waters. Confined to the latter seem to be the other much bigger forms of Scomber. I regret to say that nothing is known about their biology, or about the conditions of their distribution.

The Tunas and Bonitos are found above deep water or at the most at the edges of the shelf seas. Only some of the smaller forms are exceptions to this rule. In the Java Sea one meets regularly schools of a dwarf tuna: *Neothunnus rarus* Kishinouye and there are two dwarf bonitos, viz. *Auxis species* and *Euthynnus alletteratus affinis* (Cantor). Whereas *Neothunnus rarus* to my experience seems to be rare above deep waters; the two others are found there more regularly, though always in close vicinity to the coast. Larger forms of tunas as well as of bonitos prefer open water above great depths, though I have the impression that the skipjack or striped bonito (*Katsuwonus pelamis L.*) is often found nearer to land than the true tunas, as for instance the yellow fin. (*Thunnus neothunnus macropterus* (Schlegel).

It is little that we know about the distribution of the latter two. They seem to avoid shelf seawater and seem to prefer long open stretches of ocean. The striped bonito is found nearer inshore than the yellow fin.

How little we actually know about these true-pelagic types is illustrated by the fact that I discovered *Gymnosarda nuda* (Gunther) in rather great numbers in the Molucca seas, a locality from which it had not been described previously.

Cybium species are locally of some importance, as for instance at the south west coast of Borneo, where a special Cybium fishery is conducted for a few months of the year.

As a result of this short review we come to the conclusion that there are two groups of fishes with pelagic habits; (a) small sized species which have their greatest density in the shelf sea areas and (b) large sized species which have their greatest density above deep seas. As a consequence of this the pelagic fisheries, technically as well as economically, can also be divided into two.

Considering now the pelagic fisheries in the shelf seas from this area, the fisheries depend, therefore on Clupea species as well as on *Decapterus*, *Caranx leptolepis* and *Scomber species* and to a lesser degree on *Stromateurs niger*, we see that there is only one single method in use. This method may vary in small technical details from place to place, but the biological essentials on which it depends remain the same everywhere.

The fishermen here make use of the habit of all young Carangids to gather around or below some floating object. It is well known for instance that young Caranx gather below jelly fish or below a piece of wood or a floating leaf or such.

The fishermen cunningly devise a lure to attract the fish and to concentrate them.

A rope is lowered into the sea with an anchor—mostly consisting of a few heavy stones only—

to hold it in place and with one or more bamboos at the upper end to act as a kind of buoy. At regular distances a piece of coconut leaf is inter-twisted in the rope. These leaves act as a lure to passing schools of certain kinds of fish and they stay in the vicinity. This lure is called by the Javanese fishermen a "rumpon".

After a few days in the sea the rumpon is ripe for the fishing. At day-break the prahu arrives at the rumpon and immediately the fishing begins. A so-called pajang net, which is a kind of seine, with the upper line shorter than the lower, is rowed out around the rumpon in a semi-circle. At the outer ends of the net are two ropes, one of which remains on board while the other one is brought by a swimmer around the rumpon. The prahu now takes position in such a way that the rumpon is in the middle between the open net and the boat. The swimmer with the rope climbs on board and immediately the crew begins to haul in the net.

In the meantime, the small by-boat is set out and one man hauls in the rumpon carefully so as not to chase the fish away. Soon the lower line of the net passes under the partly hauled up rumpon and then the rumpon is hauled up totally while the net is taken further on board. The rumpon is lowered in position again now outside the net and is ready to attract new fish.

The biological features on which this method depends are interesting, but often very puzzling and much still remains to be found out.

Thousands of such rumpons lie scattered over the Java Sea and other parts of the Indo-Australian Archipelago. Though mostly used in the rather shallow shelf seas, the rumpon is used too in deep water. The rumpon is not hauled up there, but the net is dragged into the boat alongside the rumpon, which can be used until the rope has rotted away.

As there is always some current in the sea, we see the curious and hitherto unexplained fact that the fish always gather upstreams from the rumpon. Fishery alongside the rumpon means, of course, that we are fishing only half of the accumulation of fish. It seems, however, that this loss is made good by the much greater catches made above the deep water.

In clear water the catch is possible only at day-break, because only then the fish swim sufficiently near the surface to be caught. As the sun rises they sink deeper and deeper out of reach of the net.

As I have stated already all specimens of *Decapterus* are immature or just mature. The *Decapterus* fisheries depend, therefore, on a special part of the life-cycle of the fish. At first sight it seems to be worth while to look to other methods to make it possible to get hold of older fullgrown specimens. Some other kind of gear, as for instance the Vigneron Dahl trawl, should perhaps be used.

However, I do not think that any satisfactory results will be obtained. Schools of *Decapterus* seem to be small, as is generally the case here in the tropics. One should not forget that the task of the rumpon is to concentrate the fish at a given spot and to hold them there for some time. Fishermen know quite well that a new "rumpon" takes several days to ripen; or in other words, it will be a few days before schools, passing at random, when attracted by the lure will remain there and accumulate in sufficient quantity to make it worth while putting out the catching gear.

Two reflexes of the fish are to be taken into account here. First there is a schooling reflex, possessed by many fish, whereby individuals assemble together and groups of individuals congregate into larger schools, and secondly the reflex or habit of staying and remaining in the vicnity of drifting objects.

The only way to develop this kind of fishery as far as I see, is to multiply the number of rumpons and this of course, especially in those parts of the sea where this technique is not used thus far. It is only in this way that I see a possibility of enlarging the total of the landings.

Every shallow sea or part of a sea within the area of the Council will get better or lesser results. Only narrow channels with heavy tides should be excluded, for they are unsuitable for purely technical reasons.

While specimens of *Decapterus* seem to lose the "rumpon" reflex, as we may call it, with maturity—which many other Carangids do—this seems not to be the case with *Caranx leptolepis* and the same can be said of the Clupeids and the Scomber species and of the pomfrets, but on the other hand not of young *Elagatis bipinnulatus*.

In some local areas of the shelf sea a special fishery on Cybium by trolling is found. Since this species is valuable, it would be worth trying to find other localities where this fish is found in greater abundance than normal. There is perhaps more than one species involved in this fishery. As the fish is caught, with developed roe, during only a few months

of the year, one may think of the suggestion that the fishery operates in spawning localities, to which the fish migrate during certain months of the year.

Knowledge on distribution in time and space is too scarce up till now, to say more on this subject. The fishermen complain that sometimes the fish are plentiful but not biting, just as with the tunas.

Turning now to the deep waters, I wish to mention here first two curious methods of fishing on pelagic fish.

The fisheries on flying fish, as found in the Macassar Strait, as far as I know are unique. Small bamboo bownet shaped baskets are tied behind a drifting boat. Pieces of seaweed are attached to the front of the baskets. The female fish swim between these pieces, sets her eggs and by swimming further comes into the basket and is trapped. This goes on day after day, while the fishing boat is drifting by wind and current. Though the method seems rather primitive the amount of fish landed by it is rather great and may amount to 7,000 tons a year, as in 1947, which was a very good year.

These and the preceding figures were collected by the Sea Fisheries Institute at Batavia.

Another interesting method of catching pelagic fish is what I should like to call the method of the drifting islands. They are large bamboo rafts and are anchored in the amazing depth of 1000—1500 metres, with a rope of twisted rotan. Pieces of coconut leaves are let down from the sides of the raft so that we have here a variation of the rumpon method of shallower seas. The catches are the same as with the rumpon therefore, chiefly Decapterus species, and further, the already mentioned Clupea and Scomber. But, moreover, in these waters schools of tuna or skipjack are attracted to the fish gathering around the rumpon and are caught by trolling. The always difficult bait problem is solved here at once by bringing the tuna to the bait and not the bait to the tuna and besides this the bait is used as a commercial catch too.

Of growing importance in our equatorial waters are the tuna fisheries of which the pre-war Japanese fishery people know more than we do now and I think that our knowledge of them in the Indian Ocean is even more scanty.

The tunas and bonitos are generally species living above deep water, small species like *Neothunnus rarus (Kishinouye)*, *Euthynnus alletteratus* (Cantor) and *Auxis species* excepted. They can be found in shallow seas too, provided that the water is clear and has the required salinity. Though the catch of these species is unimportant from a western standpoint, for the native population of our regions they are perhaps the most important. In the first place the people can handle the smaller fish better than the larger ones and for the catch in great quantities the bigger more oceanic species need better gear, methods and boats than they have at their disposal nowadays.

Two forms of the bigger species, a tuna and a bonito, seem to be the most important. These are *Thunnus macropterus* (Schlegel) and *Euthynnus pelamys* (L). The former is found in more open water than the latter which is frequently found near the coast and within the waters between island groups.

Personally—and I must lay stress on the word personally—I have the impression that the optimum density of both species is found along edges of currents, which of course is not so surprising as we will find there the greatest density of all other organisms too and as a consequence the best chance for the fish to get food.

The tunas and allied forms belong to one of the most difficult groups for the biologist and it is only in the latter years that there is something, though still very little, known about their biology, as well as about their differentiation into races or special stocks in different parts of the ocean. The differentiation into races is a wearisome task and takes up much time and can be done only by the specialist.

Investigations of the consistency of different races in the Indo-Australian Archipelago have begun, though it is much too early to say much about this. It seems that the relation between width and length, as has been found for instance in Australian waters, seems to hold good. It is a pity, however, that this relation is not visible at a single glance. If this had been the case, then the minor fishery officials could give us valuable information about the occurrence of different groups to give us an insight into questions of migration, and migration there certainly is.

There is, however, a possibility that in the Skipjack one race can be recognised at once, even by the non-biologist. The root of the tail is normally blackish and I have found, in waters at the north of the Celebes, separate schools with whitish tailroots. Some time later they disappeared out of the catches and according to the local fishermen they had migrated southward. This difference in colour had

certainly nothing to do with the stage of maturity as fish of both groups had the same stage of ripeness.

Where exactly yellowfin tuna and skipjack spawn exists is for the greater part still a mystery. Recently Schaefer and Marr found some empty yellowfin and skipjack near the Marshall Islands. I never saw skipjack thus far in my part of the world, though local fishermen told me that the Japanese had them once or twice and they told me too that an occasional young skipjack of the length of a hand is sometimes seen. Empty yellowfin, however, were sporadically found. This was contrary to expectation as skipjack is caught much more inshore than the yellowfin in several instances and one should expect, therefore, that the skipjack would spawn nearer to the coast, whereas the yellowfin is more oceanic. This is clearly shown by the distribution of the two species. The skipjack is found sometimes in great numbers in the inland seas, whereas the yellowfin becomes rarer and rarer the greater the distance from the open ocean.

Good catches of tuna and skipjack can be made in our tropical waters. Comparison with regions like Japan and California is still rather difficult, as equipment is by far not up to standard and the fishery on tuna is, as is the case with all other local fisheries, a one day operation so that the fishermen do not venture out far into the sea.

The difficulties and, as a consequence of this, the complaints of the fishermen are the same as everywhere else. Sometimes schools bite, sometimes not, and it is a belief among the fishermen in the Moluccas that non-biting schools occur more frequently at the time of the full moon than at the new moon. Several reasons for this peculiar behaviour may be put forward, but none of them has in the ultimate been proved.

The bait problem is, as elsewhere, a difficulty too. Yet I think that the opportunity to get bait in sufficient quantities is greater here than for instance along the coast of California and Mexico. The great number of small bays, inlets, narrow channels between islands, with a great diversity of biological conditions, will give rise to the existence of schools of small fish, either consisting of small species or of immature specimens of bigger species.

Shallow parts of the coast with patches of coral are to be specially mentioned in this respect. A long open coast will in all probability give not so good a result since schools of small fish will be more dispersed and as a consequence the possibility for a good catch will be less. A comprehensive study of charts will show the probable good shores for bait catches.

The method used over here to catch the schools is one differing from that used, for instance, on the California Coast. The bait fishermen attract the fish with light, a method often used in other fisheries. At some suitable spot one or more boats silently drift with a burning light over the stem. Often two or three boats work together. As soon as sufficient fish have accumulated the boats move gently and slowly to the shore, where another light is already burning. When shorelight and boat lights have come together the boatlights are dimmed and put out and the fish remain now in the vicinity of the shorelight.

A shore-seine is brought now into a semicircle around the gathering fish from the shore and as soon as the encirclement is complete the fish are brought into one or more fine meshed sack-like nets where the fish remain until in the morning they are brought over into the fishing-boats. When the catch is abundant the same performance is repeated.

One should perhaps expect the contrary and a double performance when the catch is poor, but this is not possible as in this case the whole act requires too much time, since the boats will wait a long time before making for the shore.

The difficulty with the above described method is of course the moon and this would prove doubly difficult should it be true that the tunas will bite better at full moon than at new moon. When there are plenty of tuna bait is scarce and the vice versa. The problem of eliminating the moonlight has not been solved thus far.

Bait consists of a diversity of species. In those cases where I examined a sample anchovies were in the majority. Next were young *Clupea* and *Scomber* and sometimes large quantities of young *Caesio*. To my surprise I once saw a fairly good catch of *Upeneus* and a *Tetrodon* species.

It seems that now and then the Japanese used fingerlings of *Chanos chanos*, the milkfish reared in ponds. This should be at least something to help us at times when bait is scarce, but it is up to the economist to make a calculation whether it is more profitable to let these fingerlings grow until they are marketable or not.

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